NEXCEL
Nonmetallic Excellence and Innovation Center for Building Materials
非金属材料创新中心

aramco 沙特阿美

CNBM | CBMA



NEXCEL ANNUAL REPORT 2024

MAR 2025

NEXCEL JOURNEY



NEXCEL INAUGURATION CEREMONY

JAN 2022



APR 2022

RELEASE OF NEXCEL 2022 PROGRAM GUIDELINE

JUL 2022

KICK-OFF OF 16 PROJECTS FOR 2022 PROGRAM



SEP 2022

RELEASE OF NEXCEL 2023 PROGRAM GUIDELINE



FEB 2023

KICK-OFF OF 15 PROJECTS FOR 2023 PROGRAM



JUL 2023

5 2022SFP PROJECTS COMPLETED



AUG 2023

RELEASE OF NEXCEL 2024 PROGRAM GUIDELINE



SEP 2023

ARAMCO EVP VISITS NEXCEL



FEB 2024

KICK-OFF OF 22 PROJECTS FOR 2024 PROGRAM

AUG 2024

4 2022TDA & 4 2023SFP PROJECTS COMPLETED

PERFORMANCE 2022-2024

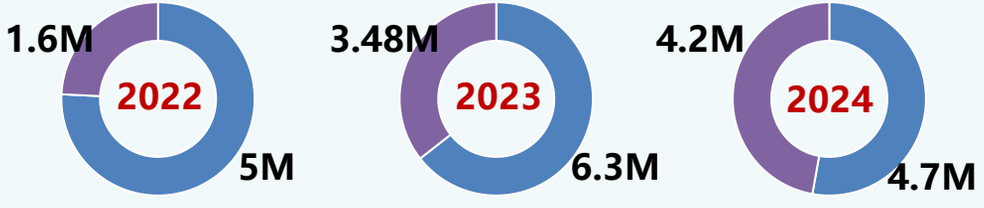
53 NEXCEL Projects

- 26 PROJECTS Ongoing
- 27 PROJECTS Completed

NEXCEL Impact

- > 31,000 Tons — Polymer Use
- > 50 Engineering — NM Deployment
- CO_2 > 10,000 Tons
- > 50% — Waste Recycling

Program Fund



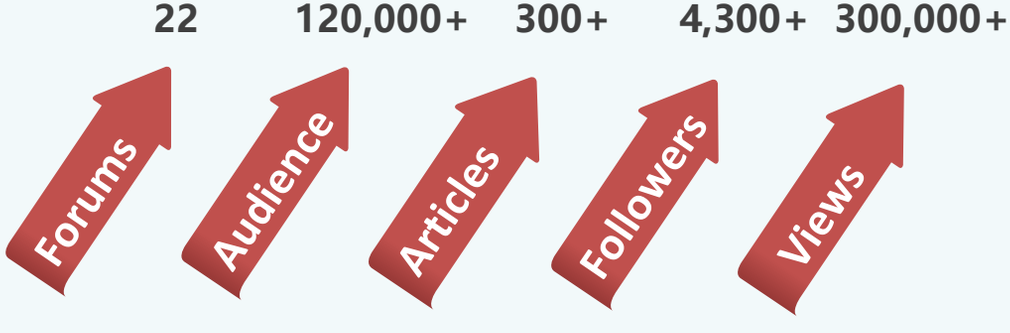
Outreach & Partnership

- 78 Outreach Visits
- 72 Partners
- 7 MOUs

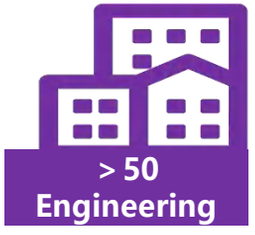
Projects Outcomes

- Products 8
- Technologies 5
- Papers 64
- Patents 39
- Standards 10
- Demonstrations 22

Advocacy



NEXCEL IMPACT

	 Polymer Use	 NM Deployment	
Fibers, Rebars, and Fiber Composites (FRPs)	208	33	564
Pavement for Roads & Bridges	30558	10	6110
Special Mortars & Concrete	1	1	n/a
Construction Chemicals	154	8	301
Waterproofing & Repair Materials	480	4	n/a
Insulation & Composite Cladding	200	2	3100
Total	31601	58	10075

CONTENTS

01 INTRODUCTION

About NEXCEL.....07
Steering Committee.....12
Technical Advisory Committee.....14
Partners 16

02 PERFORMANCE

Project Category.....20
Meetings.....25
Project Outcomes.....26

03 PROJECT AREAS

Fibers, Rebars, and Fiber Composites.....38
Special Mortars & Concrete.....68
Pavement for Road&Bridges.....86
Construction Chemicals.....106
Waterproofing & Repair Materials.....118
Insulation& Composite Cladding.....124

04 ADVOCACY

Advocacy KPI.....137
Strategic Partnership.....143
Outreach.....144

05 OUTLOOK

The Way Forward.....146

06 APPENDIX

Appendix.....150
Acknowledgement.....170



PART 1

INTRODUCTION

ABOUT NEXCEL

VISION

Transform the building and construction sector to non-metallic based materials to improve sustainability, asset lifecycle and lower carbon footprint.

MISSION

Expand and accelerate non-metallic technology deployment in the building and construction sector by developing and advocating non-metallic products, establishing and transforming non-metallic material standards and regulations, fostering effective non-metallic material awareness and training for the building and construction community.

ABOUT NEXCEL

Non-metallic Excellence and Innovation Center for Building Materials (NEXCEL) is jointly established by Saudi Aramco, the world's largest producer of energy and chemical products, together with China National Building Material Group (CNBM), the world's largest building materials manufacturer and services provider, and China Building Materials Academy (CBMA), the largest comprehensive scientific research institution for building materials in China. Saudi Aramco as the founding sponsor of NEXCEL and CBMA as NEXCEL’ s operator are working together to accelerate non-metallic technology deployment in the building and construction sector, and deploy innovative non-metallic technologies to provide more sustainable construction solutions.

MESSAGE FROM NEXCEL



SC CHAIRMAN
Prof. ZHI Xiao

"The building materials industry is currently evolving towards higher efficiency, greater environmental-friendly, and enhanced intelligence. This transition is crucial for meeting sustainability goals and construction demands. NEXCEL, sponsored by Aramco and operated by China Building Materials Academy, is a network of 40 universities and 60 industry partners across the world. The center explores novel construction materials to inspire technological innovation throughout the sector with the overarching goal of creating more durable and more resilient materials, ultimately contributing to a more efficient, and sustainable world."



SC MEMBER
Eng. Hussain Albinali

"At Aramco, we have taken the leading role to deploy nonmetallic materials in our own facilities. In building and construction sector, we are working to evolve more than 75 different nonmetallic and composite applications to have better acceptance and adaptation. We have seen a lot of realized value and benefits from using nonmetallic materials which contributes to huge cost saving and lowering CO_2 footprint. As of today, Aramco co-funded 53 projects through NEXCEL to support china market and material transformation. Our collaboration with NEXCEL is one example of our industrial supporting efforts and we are happy to see good progress and excellent outcome in fulfilling the four core functions of NEXCEL. "



PROGRAM DIRECTOR
Dr. LI JUAN

"NEXCEL, as an international innovation platform, gathered a technical committee composed of top experts, as well as a range of interdisciplinary and multidisciplinary project teams. Over the past three years, NEXCEL has achieved a series of remarkable outcomes, incl. 64 papers, 39 patents, 10 standards, and over 50 deployments. These outcomes resulted in over 1,000 organic plastic wastes recycling, over 10,000 tons of CO_2 reduction, which is equivalent to one million trees are planted. On behalf of NEXCEL, my sincere gratitude goes to everyone who contributed to these excellent outcomes. Together with our industry and university partners, we will keep on exploring and turning over new ideas and sparking technological innovation throughout the construction industry to ensure a promising future."

WIN-WIN COOPERATION

aramco 沙特阿美

The world's largest producer of energy and chemical products

Non-metallic Strategy

New Materials Strategy

CNBM

The world's largest building materials manufacturer and services provider

CNBM | CBMA

The largest scientific research institution for building materials in China

NEXCEL

非金属材料创造更美好世界

To build a promising future with non-metallic materials

FOUR CORE FUNCTIONS

Technology Development
技术创新

Standards & Specifications
标准引领

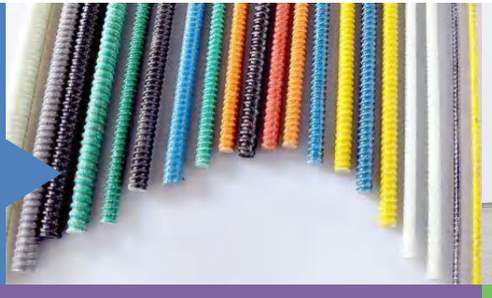


宣传培训
Advocacy & Training

产业应用驱动
Application & Acceleration

SIX FOCUSED AREAS

Fibers, Rebars, and Fiber Composites (FRPs)





Special Mortars & Concrete



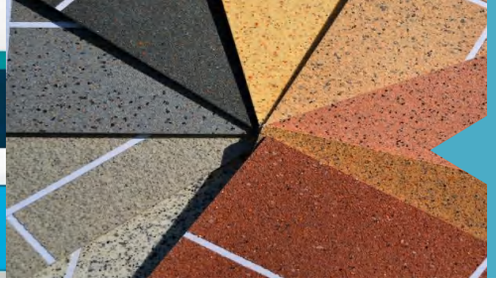
Pavement for Roads & Bridges

Construction Chemicals



Waterproofing & Repair Materials





Insulation & Composite Cladding

1st STEERING COMMITTEE

(2022-2023)

CNBM | CBMA



MA Zhenzhu
President
CBMA



HOU Diyang
CEO
CBMA



WANG Hua
Head of Xianyang Research & Design Institute of Ceramics
CBMA

aramco



Waleed Al-Otaibi
Director of IIP Transaction
Saudi Aramco
Steering Committee Chairman



Mohammed Al-Qahtani
Manager of Technology Management
Saudi Aramco



Riyadh Shiban
Manager of Civil & Structural Engineering
Saudi Aramco

2nd STEERING COMMITTEE

(2024-Now)

CNBM | CBMA



ZHI Xiao

President

CBMA

Steering Committee Chairman



HOU Diyang

CEO

CBMA



QIU Yan

Director of Science and Technology

CBMA

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Waleed Al-Otaibi

Director of IIP Transaction

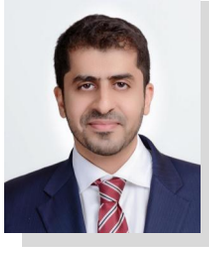
Saudi Aramco



Mohammed Al-Qahtani

Manager of Technology Management

Saudi Aramco



Hussain Albinali

Manager of Nonmetallic Engineering

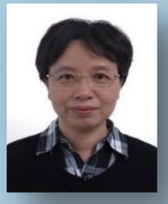
Saudi Aramco

TECHNICAL ADVISORY COMMITTEE (TAC)

TAC TASK FORCE



YAO Yan
Professor
China Building Materials Academy
TAC Chairlady
CNBM | CBMA



WANG Ling
Professor
China Building Materials Academy
CNBM | CBMA



XUE Weichen
Professor
Tongji University



Mohammed Mehthel
Principal
Professional
Saudi Aramco
aramco



Oscar Salazar
Engineering
Consultant
Saudi Aramco
aramco



Waseem Khatri
Professional
Engineer
Saudi Aramco
aramco



FENG Peng
Dean/Professor
Tsinghua University



Hasan Khalifah
Professional
Engineer
Saudi Aramco



HUANG Songchang
Deputy Chief Engineer
Research Institute of Highway Ministry of Transport



JIA Jinsheng
Professor
China Building Materials Academy



Kurt Ke
Lead Engineer
Aramco Asia



LI Xiaoyu
Professor
Beijing University of Chemical Technology



LIANG Fan
Senior Engineer
Harbin FRP Institute



LV Mingfu
Professor
Institute of Plastics Processing of Beijing Research Institute of Chemical Industry



Mirza Baig
Professional
Engineer
Saudi Aramco



Mohammad Salloum
Professional
Engineer
Saudi Aramco



NI Wen
Professor
University of Science and Technology Beijing



Saleh Wohaibi
Professional
Engineer
Saudi Aramco



SUN Shibing
Professor
Beijing University of Technology



SUN Zhenping
Professor
Tongji University



YAN Chunze
Professor
Huazhong University of Science and Technology



YANG Xiaoping
Professor
Beijing University of Chemical Technology



YANG Xiaoyu
Professor
Wuhan University of Technology



ZHANG Yong
Chief Engineer
China National Building Waterproof Association

STRATEGIC CONSULTANT



YUE Qingrui

Academician of China Academy of Engineering

University of Science & Technology Beijing



LIU Jiaping

Academician of China Academy of Engineering

Southeast University



LI Zongjing

Fellow of American Concrete Institute

Macau University of Science and Technology

TECHNICAL SUPPORT & LIAISON OFFICE



Mohammed Al-Salloum

Saudi Aramco



Dakhel Aldakhil

Saudi Aramco



Hongxiang WANG

Aramco Asia



Kurt Ke

Aramco Asia



ZHOU Chunying

CBMA

UNIVERSITY

清華大學 Tsinghua University

哈爾濱工業大學 HARBIN INSTITUTE OF TECHNOLOGY

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

中南大學 CENTRAL SOUTH UNIVERSITY

武漢理工大學 WUHAN UNIVERSITY OF TECHNOLOGY

中铁检验认证 CRCC

上海交通大學 SHANGHAI JIAO TONG UNIVERSITY

同濟大學 TONGJI UNIVERSITY

西安交通大學 XI'AN JIAOTONG UNIVERSITY

中国地质大学 CHINA UNIVERSITY OF GEOSCIENCES

山东大学 SHANDONG UNIVERSITY

沪誉 HUYUJIANKE

皓强科技

浙江大學 ZHEJIANG UNIVERSITY

長安大學

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

南京工業大學 NANJING TECH UNIVERSITY

河北工業大学 HEBEI UNIVERSITY OF TECHNOLOGY

CKS 科顺

ctc 国检集团

湖南大學 HUNAN UNIVERSITY

華南理工大學 South China University of Technology

北京交通大學 BEIJING JIAOTONG UNIVERSITY

中山大學 SUN YAT-SEN UNIVERSITY

葛洲坝集团 JIAPENG GROUP

交通运输部公路科学研究院 RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

中國矿业大學(北京) CHINA UNIVERSITY OF MINING AND TECHNOLOGY-BEIJING

哈尔滨玻璃钢研究院有限公司 Harbin FRP Institute Co.,Ltd.

北京化工大學 BEIJING UNIVERSITY OF CHEMICAL TECHNOLOGY

SPARE

江苏宿迁交通工程建设有限公司 Jiangsu Suqian Traffic Engineering construction Co. LTD

PROJECT PARTNER

CityU 香港城市大學 City University of Hong Kong

合肥工業大學 HEFEI UNIVERSITY OF TECHNOLOGY

中国能建 ENERGY CHINA

葛洲坝集团交通投资有限公司 GEZHOUBA GROUP TRANSPORTATION INVESTMENT CO., LTD.

中国建科

中国建筑标准设计研究院有限公司 CHINA INSTITUTE OF BUILDING STANDARD DESIGN & RESEARCH

Université de Lille

贵州省公路工程集团有限公司 GUIZHOU HIGHWAY ENGINEERING GROUP CO., LTD

中国建筑第八工程局有限公司 CHINA CONSTRUCTION EIGHTH ENGINEERING DIVISION CORP., LTD

兆维 CHOICEWAY

安珈新材料 AEGA ADVANCED MATERIALS

江苏恒美德新材料有限公司 Jiangsu Chemlead New Material Co., Ltd.

中铁工程设计咨询集团有限公司 China Railway Engineering Design and Consulting Group Co.,Ltd.

中国中铁

NELD 耐尔得

泰山玻璃纤维有限公司 Taishan Fiberglass Inc.

中复碳芯电缆科技有限公司 ZHONGFU CARBON CORE CABLE TECHNOLOGY CO., LTD

中国建材

中国建筑材料科学研究总院 中建材中岩科技有限公司 CNBM Zhongyan Technology Co., Ltd.

TEC

北京秦天科技集团有限公司 Beijing Qin Tian Science&Technology Group Co., LTD.

中国建筑防水协会 AAAAA级社会组织 全国先进社会组织

中国复合材料学会 CHINESE SOCIETY FOR COMPOSITE MATERIALS

中国建筑材料联合会 China Building Materials Federation

INDUSTRY

PROJECT SPONSOR

中国建筑材料科学研究总院
中建材中岩科技有限公司
CNBM Zhongyan Technology Co., Ltd.

CKS 科顺

CCTC 中国建科 中国建筑标准设计研究院有限公司
CHINA INSTITUTE OF BUILDING STANDARD DESIGN & RESEARCH

安珈新材料
AEGA ADVANCED MATERIALS

WANHUA

ctc 国检集团

北京秦天科技集团有限公司
Beijing Qin Tian Science&Technology Group Co., LTD.

沪誉 HUYUJIANKE

江苏恒美德新材料有限公司
Jiangsu Chemlead New Material Co., Ltd.

CEEC 中国能建 ENERGY CHINA | CGGC 葛洲坝集团交通投资有限公司
GEZHOUBA GROUP TRANSPORTATION INVESTMENT CO., LTD.

哈尔滨玻璃钢研究院有限公司
Harbin FRP Institute Co.,Ltd.



PART 2

PERFORMANCE

PERFORMANCE 2024

PROJECT OUTCOMES

- 8 PRODUCTS
- 5 TECHNOLOGIES
- 30 PAPERS
- 19 PATENTS
- 6 STANDARDS
- 10 DEMONSTRATIONS
- 17 TALENT CULTIVATIONS

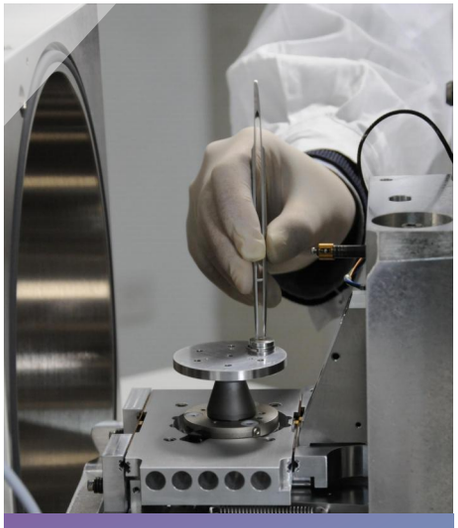


PROJECT PROGRESS

2022 PROJECT	4 TDA	5 SFP	3 PHD	3 ATP
2023 PROJECT	6 TDA	4 SFP	3 PHD	3 ATP
2024 PROJECT	5 TDA	4 SFP	10 PHD	3 ATP

COMPLETED ONGOING

PROJECT CATEGORY



Technology Development and Acceleration Project (15 TDA)

4 Projects/2022
6 Projects/2023
5 Projects/2024

Duration: 2 Years



Small Fund Project (13 SFP)

5 Projects/2022
4 Projects/2023
4 Projects/2024

Duration: 1.5 Year



Ph.D. Scholarship Project (16 PHD)

3 Projects/2022
3 Projects/2023
10 Projects/2024

Duration: 2 Years



Advocacy or Training Project (9 ATP)

3 Projects/2022
3 Projects/2023
3 Projects/2024

Duration: 1 Year

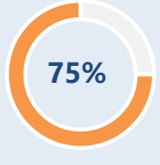
2022 PROJECT PORTFOLIO

			START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA1-1	Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members	JUL 2022	JUN 2024	100%	Completed
2	TDA2-4	Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration	JUL 2022	JUN 2024		
3	TDA3-1	Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer	JUL 2022	DEC 2024		
4	TDA4-1	Development and demonstration of composite lattice tower for communication and power transmission over 15m	JUL 2022	JUN 2024		
SMALL FUND PROJECTS						
5	SFP1-1	Research on 3D printed polymer modified concrete and its interface enhancement technology	JUL 2022	JUN 2023	100%	Completed
6	SFP2-1	Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil	JUL 2022	JUN 2023		
7	SFP3-1	Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement	JUL 2022	JUN 2023		
8	SFP4-1	Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel	JUL 2022	JUN 2023		
9	SFP5-1	Study on key technology of polymer modified inferior coarse aggregate	JUL 2022	JUN 2023		
PHD PROJECTS						
10	PHD-1	High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components	JUL 2022	JUN 2026	80%	Extended to 2026
11	PHD-2	Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate	JUL 2022	JUN 2024	100%	Completed
12	PHD-3	Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials	JUL 2022	JUN 2026	80%	Extended to 2026
ADVOCACY PROGRAMS						
13	ATP-1	The 10th ISCC parallel session on petroleum-based building materials	JUL 2022	DEC 2022	100%	Completed
14	ATP-2	Advocacy activities for the application of petroleum-based concrete admixture in low-carbon concrete	JUL 2022	DEC 2022		
15	ATP-3	2022 NEXCEL series of forum	JUL 2022	DEC 2022		

2023 PROJECT PORTFOLIO

			START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA1-1	Develop hydrocarbon-based graphene for improving properties of concrete	JAN 2023	DEC 2024		Extended to JUN 2025
2	TDA2-2	Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life	JAN 2023	DEC 2024		
3	TDA3-2	Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings	JAN 2023	DEC 2024		
4	TDA4-1	Preparation and application of FRP bent bar under corrosive environment	JAN 2023	DEC 2024		
5	TDA5-1	Fire endurance and creep resistance improvement for application of GFRP rebars	JAN 2023	DEC 2024		
6	TDA6-2	Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete	JAN 2023	DEC 2024		
SMALL FUND PROJECTS						
7	SFP1-2	Effects of recycled plastics on the performance of asphalt mixture	JAN 2023	JUN 2024		Completed
8	SFP2-1	Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars	JAN 2023	JUN 2024		
9	SFP3-2	Standardization and demonstration of preparing building formwork with waste plastics	JAN 2023	JUN 2024		
10	SFP4-1	Development of self-healing fire-retardant coatings highly compatible with non-metallic surfaces	JAN 2023	JUN 2024		
PHD PROJECTS						
11	PHD-1	CFRP prestressed concrete assembled raft-type floating structures	JAN 2023	DEC 2024		Completed
12	PHD-6	Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials	JAN 2023	DEC 2024		
13	PHD-8	Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites	JAN 2023	DEC 2024		
ADVOCACY PROGRAMS						
14	ATP-1	Session on composite materials in civil engineering at China composites conference	JAN 2023	DEC 2023		Completed
15	ATP-2	International conference and forum on waterproofing & repair materials	JAN 2023	DEC 2023		
16	ATP-3	2023 NEXCEL series of forum	JAN 2023	DEC 2023		

2024 PROJECT PORTFOLIO

			START DATE	END DATE	PROGRESS	MILESTONE
TDA PROJECTS						
1	TDA-1	Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure	JAN 2024	DEC 2025		Mid-term Review
2	TDA-2	Development and demonstration of polymer aerogel composites	JAN 2024	DEC 2025		
3	TDA-3	Development and demonstration of non-metallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement	JAN 2024	DEC 2025		
4	TDA-4	Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life	JAN 2024	DEC 2025		
5	TDA-5	Develop certification for external thermal insulation composite systems (ETICS)	JAN 2024	DEC 2025		
SMALL FUND PROJECTS						
6	SFP-2	Application and demonstration of FRP tube-concrete new composite structure	JAN 2024	JUN 2025		Mid-term Review
7	SFP-3	Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture	JAN 2024	JUN 2025		
8	SFP-4	Research and demonstration on the performance of thermoplastic FRP stirrup	JAN 2024	JUN 2025		
9	SFP-5	Application and demonstration of hydrocarbon-based graphene in asphalt mixture	JAN 2024	JUN 2025		
ADVOCACY PROGRAMS						
10	ATP-1	The conference on high-quality development of concrete and cement products	JAN 2024	DEC 2024		Completed
11	ATP-2	International conference on building materials 2024 (ICBM2024)	JAN 2024	DEC 2024		
12	ATP-3	2024 NEXCEL series of forum	JAN 2024	DEC 2024		

2024 PROJECT PORTFOLIO

			START DATE	END DATE	PROGRESS	MILESTONE
PHD PROJECTS						
13	PHD-1	Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement	JAN 2024	DEC 2025		
14	PHD-2	Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt	JAN 2024	DEC 2025		
15	PHD-3	Surface modification of extruded polystyrene foam and the study of its flame retardancy and adhesion performances	JAN 2024	DEC 2025		
16	PHD-4	Synthesis of phosphorus-containing metalimidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin	JAN 2024	DEC 2025		
17	PHD-5	Study on multifunctional carbon fabric reinforced seawater and sea sand concrete composite component system	JAN 2024	DEC 2025	50%	Mid-term Review
18	PHD-6	Ultimate and serviceability limit state design for FRP-UHPC hybrid beams	JAN 2024	DEC 2025		
19	PHD-7	Preparation and performance of self-healing polymer modified asphalt waterproofing membrane	JAN 2024	DEC 2025		
20	PHD-8	Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization	JAN 2024	DEC 2025		
21	PHD-9	Preparation of railway sleeper using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties	JAN 2024	DEC 2025		
22	PHD-10	Preparation and mechanism of carbon black/cement based electromagnetic wave absorbing materials with multimechanism	JAN 2024	DEC 2025		

MEETINGS 2024



SC MEETING



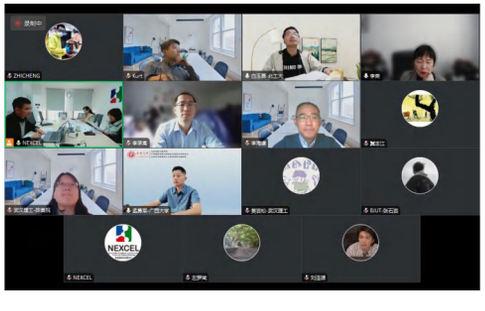
PROJECT KICK-OFF MEETING

PROJECT MID-TERM & CONCLUDING REVIEW MEETING







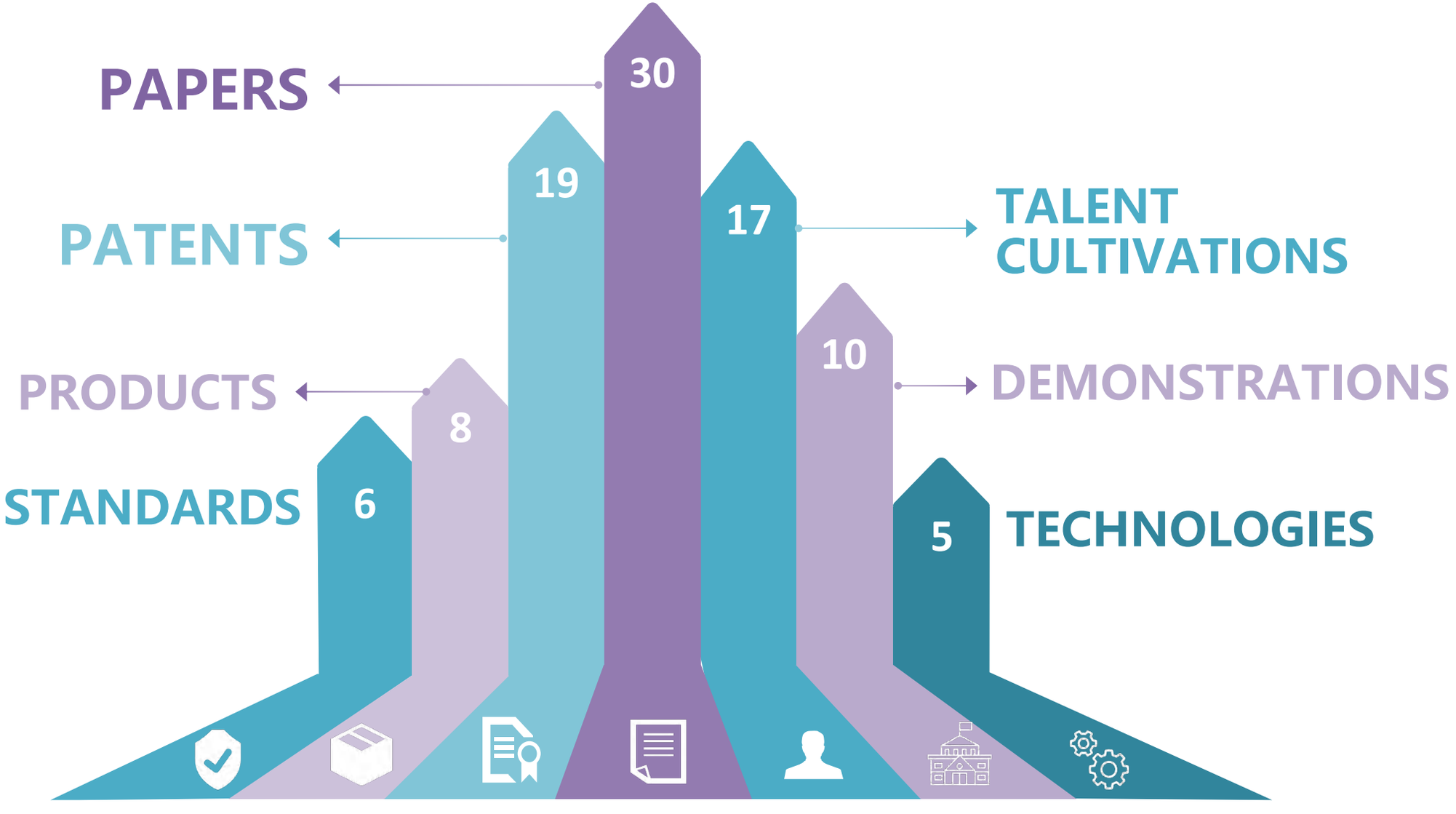


PROJECT PLANNING WORKSHOP





PROJECT OUTCOMES 2024



PRODUCT



FRP composite lattice tower



Ultra-high dispersion polycarboxylic superplasticizer



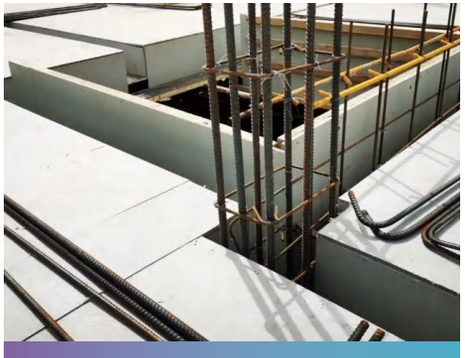
Admixture for ready-mixed fluid solidified soil



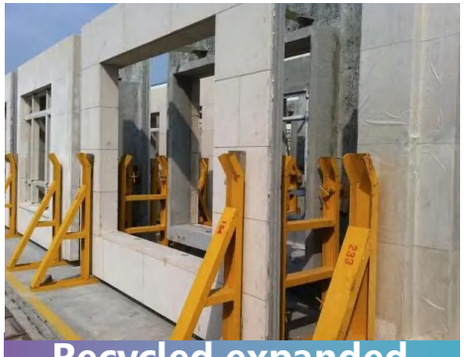
Fiber reinforced thermoplastic resin composite reinforcement



High performance fiber reinforced composite pultruded profile



Recycled plastic building formwork



Recycled expanded polystyrene particles/foam concrete composite sandwich wall panel



Novel self-healing fire retardant coating

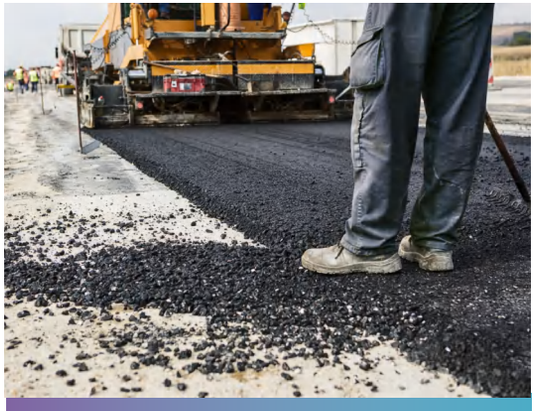
TECHNOLOGY



Mechanical foaming warm mixed asphalt



On-site recycling of waste asphalt pavement



Recycled plastic asphalt mixture



3D printing technology for construction



Polymer modified inferior coarse aggregate

PAPER

No.	Project No.	Paper Name
1	22TDA1-1	*Non-linear behaviors of pultruded GFRP composites*
2		*Flexural performance of curved-pultruded GFRP arch beams subjected to varying boundary conditions*
3	22TDA2-4	*Effect of warm mix agent on the chemo-mechanical performance of binder with different oil sources*
4	22TDA3-1	*Research on the mix proportion of low-carbon concrete utilizing a novel polycarboxylate Superplasticizer*
5		*Research on the effect and mechanism of binder-sand ratio on UHPC performance*
6	22TDA4-1	*Comparative study of standard stroke load design of communication poles and towers in China, America and Europe (in Chinese)*
7		*Improving performance of GFRP joints using bolted/mortise-tenon hybrid method*
8	22PHD-1	*Mixed-alkali effect on thermal property and elastic behavior in borosilicate glasses*
9	23TDA1-1	*Improving the interfacial properties of PVA fiber and cementitious composite: Design and characterization*
10	23TDA2-2	*Performance of thermal-oxidative aging on the structure and properties of ethylene propylene diene monomer (EPDM) vulcanizates*
11		*Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*
12	23TDA4-1	*Strength retention rate distribution model and reliability analysis of FRP stirrups (in Chinese)*
13		*Shear behavior of two-span continuous concrete deep beams reinforced with GFRP bars*
14		*Calculation method of the flexural tensile strength of the GFRP stirrups based on the database (in Chinese)*
15		*Transfer learning-based confinement strength prediction of concrete confined by FRP transverse reinforcements*
16		*Flexural behavior and design of ultrahigh-performance concrete beams reinforced with GFRP bars*
17	23TDA6-2	*Effect of styrene acrylic latex on the performance of metakaolin blended cement: From hydration to mechanical properties*

No.	Project No.	Paper Name
18	23SFP1-2	*Microscopic properties of asphalt and polyethylene at an extraordinary high dosage through molecular dynamics simulation*
19		*Preparation method and properties of high viscosity and elasticity road asphalt modified with recycled low-density polyethylene plastic at a large dosage (in Chinese)*
20	23SFP4-1	*Protective and flame retardant bifunctional epoxy-based-nanocomposite coating by intercomponent Synergy between Modified CaAl-LDH and rGO*
21		*Preparation of tung oil microcapsules and their self-healing properties (in Chinese)*
22		*Preparation of graphene oxide/aluminum hypophosphite hybrids and the improvement on flame retardancy in PC/ABS (in Chinese)*
23	23PHD-6	*Modification of early-age microstructure and enhanced mechanical properties of cement paste via injecting low-dose CO2 at fresh stage*
24	23PHD-8	*Prediction of fatigue crack propagation in center cracked steel plate strengthened with partially covered CFRP strip*
25		*Probabilistic fatigue stiffness variation of angle-ply GFRP composites considering stress ratio effect*
26	24SFP-4	*Design, preparation and mechanical properties of novel glass fiber reinforced polypropylene bending bars*
27		*Long-term properties evolution and life prediction of glass fiber reinforced thermoplastic bending bars exposed in concrete alkaline environment*
28	24PHD-4	*Multifunctional phosphorus-containing imidazoliums endowing one-component epoxy resins with superior thermal latency, heat resistance, mechanical properties, and fire safety*
29	24PHD-5	*A pull-out equivalent telescopic layered failure model of carbon fiber bundles in seawater sea-sand cementitious matrix*
30	24PHD-5	*Effect of ICCP on tensile performance and piezores effect of CFRCM plates*

PATENT

No.	Project No.	Stutes	Patent Name
1	22TDA1-1	Filed	An anchoring device for clamping carbon plates and its method of use
2		Granted	An anchoring device for clamping carbon plates
3		Granted	A carbon fiber composite plate stay cable
4		Filed	A carbon fiber composite plate stay cable
5		Filed	A strengthening device and strengthening method
6		Filed	A strengthening device
7	22TDA2-4	Filed	Activator for in-place foamed warm regeneration mixture, foamed warm regeneration mixture and its preparation method
8	22TDA4-1	Filed	A washboard corner composite profile, forming tooling and preparation method, application
9	23TDA1-1	Filed	Conductive cementitious materials based on modified aggregate coated graphene and their preparation method
10	23TDA2-2	Filed	A TPO composite waterproof membrane
11		Filed	A waterproof roll material
12	23TDA5-1	Filed	Modification of vinyl ester resin and preparation method thereof
13	23TDA6-2	Filed	A device and construction method for concrete pavement based on an imposed magnetic field
14	23SFP1-2	Granted	A type of miscible storage device for waste plastic modified asphalt
15		Granted	A device for preparing waste plastic modified asphalt
16	23SFP4-1	Filed	Preparation method and spplication of flame-retardant and self-healing epoxy-based or polyurethane-based composite coatings
17	24SFP-4	Filed	New bending device for fiber reinforced thermoplastic composite stirrups
18		Filed	Bending forming device for thermoplastic fiber reinforced composite stirrups and manufacturing method
19		Filed	New bending device and forming method for fiber reinforced thermoplastic composite stirrups

STANDARD

No.	Project No.	Stutes	Standard Name
1	22TDA1-1	Issued（T/CSTM 01345-2024)	Code of technical practice for FRP composite cooling tower structures
2	22TDA2-4	Draft for Review	Technical specification for mechanically foamed warm mix asphalt
3	22TDA4-1	Draft for Review	Specification for the manufacture of composite lattice towers for communication
7	23SFP1-2	Draft for Review	Technical specification for application of recycled plastic filler for asphalt mixture
8	23SFP2-1	Draft for Review	Thermoplastic fiber-reinforced polymer composite bar
9	23SFP3-2	Draft for Review	Recycled plastics for building plastic formwork

DEMONSTRATION

Building & Construction



TPO Waterproofing Membrane in Western (Chongqing) Science City

70% Polymer content
80% Solar reflectance
Excellent durability
Polyolefin 160 tons



PIR Insulation Material Applied to Ultra-low Energy Buildings in Beijing

Polyisocyanurate Foam (PIR) 200 tons
CO_2 ↓ 400 tons/year

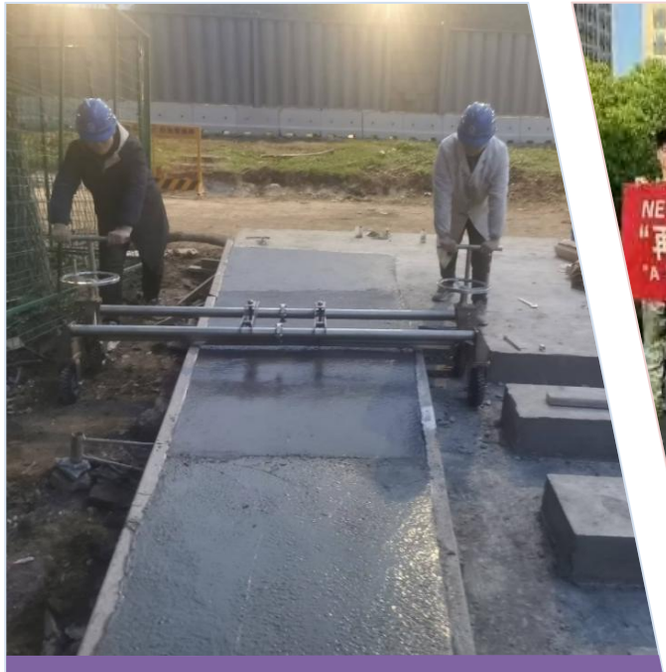


Waste Plastics Applied to Building Formwork in Xuchang, Henan

50% waste plastic
Cost ↓ 58%
CO_2 ↓ 70%

DEMONSTRATION

Pavement



Gradient Reinforced Polymer Modified Concrete Applied to Shanghai Outer Ring Road

Excellent abrasion resistance
CO_2 ↓ 15%



Asphalt Mixtures Incorporating Large Amount of Recycled Plastics Applied to the Road Reconstruction Project

Recycled plastics 33.4 tons
Fillers Cost ↓ 41%
CO_2 ↓ 16%



A Production Line of Phase Change Energy Storage Composite Particles for Asphalt Pavement

Annual production capacity of 60,000 tons

DEMONSTRATION

Infrastructures

Telecom



FRP Composite Lattice Tower Built in Guangdong

Light weight, High strength
Easy transportation
Excellent durability
CO_2 ↓ 43%

Underground



Ultra-highly Dispersing PCE Applied to the Underground Pipelines in Dezhou, Shandong

PCE 12 tons
CO_2 ↓ 20%

Bridge



Ultra-highly Dispersing PCE for UHPC Applied to Xiaoqinghe Grand Bridge in Shandong

PCE 25 tons
Ultra-high strength
CO_2 ↓ 20%

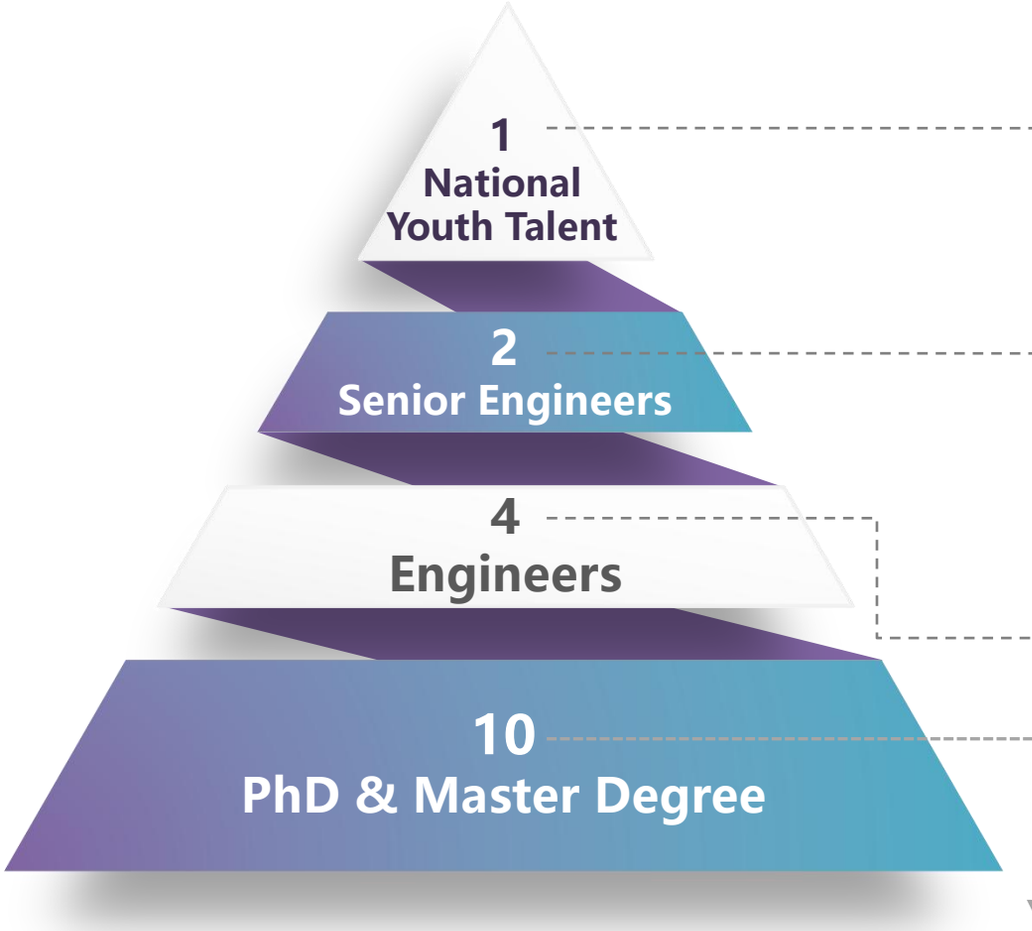
Port



FRP Rebars Applied to Lach Huyen Port in Vietnam

FRP rebars 240 tons
CO_2 ↓ 70%

TALENT CULTIVATION



BAI Yulei



LI Xiong



HUANG Hailiang



XIE Tieqin



ZHANG Tuoda



LIU Xinyi



LI Mu



ZHANG Shuang



WANG Wanling



ZHANG Jingfan



WEI Zhongjin



HU Quanchao



XIE Chongfeng



ZHOU Ping



GUO Rui



LI Jinghao



WANG Anji





PART 3

PROJECT AREAS



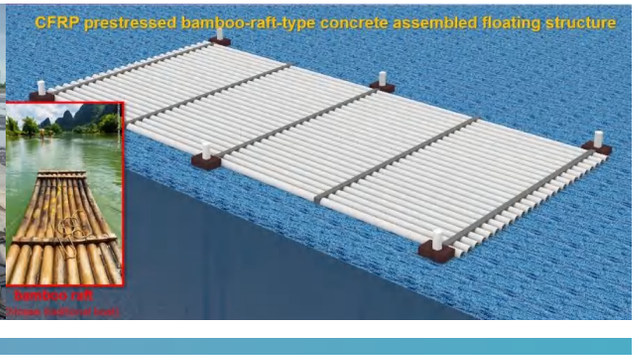
Fibers, Rebars, and Fiber Composites (FRPs)

Projects on Fibers, Rebars & Fiber Composites (FRPs)		
1	22 TDA1-1	Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members
2	22 TDA4-1	Development and demonstration of composite lattice tower for communication and power transmission over 15m
3	22 PHD-1	High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components
4	23 TDA4-1	Preparation and application of FRP bent bar under corrosive environment
5	23 TDA5-1	Fire endurance and creep resistance improvement for application of GFRP rebars
6	23 SFP2-1	Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars
7	23 PHD-1	CFRP prestressed concrete assembled raft-type floating structures
8	23 PHD-8	Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites
9	24 TDA-1	Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure
10	24 SFP-2	Application and demonstration of FRP tube-concrete novel composite structure
11	24 SFP-4	Research and demonstration on thermoplastic FRP stirrup
12	24 PHD-4	Synthesis of phosphorus-containing metalimidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin
13	24 PHD-5	Study on multifunctional carbon fabric reinforced seawater and sea sand concrete composite component system
14	24 PHD-6	Ultimate and serviceability limit state design for FRP-UHPC hybrid beams









Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2022 TDA1-1
(JUL 2022 - JUN 2024)

Project Name: Comprehensive promotion and improvement of FRP reinforced composite materials and engineering structural members

BACKGROUND

Fiber reinforced polymer (FRP) composites, owing to their advantages of lightweight, high strength- and stiffness-to-weight ratios, excellent corrosion resistance and superior fatigue performance, have shown great potential in the field of civil engineering worldwide. Nonetheless, due to low modulus of elasticity, lack of robust connection method, significant brittle sudden failure mode, poor fire resistance, and uncertainty in creep performance, FRPs have not been universally-accepted in practice. This is manifested by the facts that the civil engineers tending to adopt FRPs do not have full confidence in the material, and those engineers who have the confidence in material do not have sufficient skills of designing with FRPs.

AIMS AND GOALS

- To propose 1 or 2 FRP joint nodes with pultrusion process;
- To develop fiber composite rebar with good ultimate tensile strain and post yield strain;
- To develop composite profiles with high in-plane shear strength and equivalent tensile strength;
- To enhance the overall performance of composite structural parts with high efficiency of material strength and high ductility factor at the ultimate state;
- To reach fire protection grade B1 and fire resistance limit of the horizontal load-carrying parts ≥1 h;
- To develop design methods for highly-ductile composite structure parts.



PI: Prof. LIU Tianqiao

PROJECT TEAM

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

SPARE 南京斯贝尔复合材料仪征有限公司

中国矿业大学(北京) CHINA UNIVERSITY OF MINING AND TECHNOLOGY-BEIJING

INNOVATIONS

- Developed a novel type of anchorage system of corrugated anchor for prestressed CFRP plates. This system is composed of corrugated steel plates and high-strength bolt fastenings.
- Improved the anchorage efficiency by using the thicker anchor plate with epoxy adhesive, and the optimum anchor configuration was found to be 30 mm thick anchor plate with epoxy adhesive together with 150 N·m retightening torque, and the nominal ultimate tensile strength of the CFRP plate reached 2100 MPa.

3 PATENTS

- A type of anchor for gripping CFRP plate
- A fire-resistant and flame-retardant pultruded fiber reinforced composite and its manufacturing method
- A fire-retardant pultruded fiber reinforced composite profile

1 STANDARD

- Standard test method for tensile properties of pultruded fiber reinforced polymer composites - using a dual-tapered specimen

5 PAPERS

- *Flexural performance of curved-pultruded GFRP arch beams subjected to varying boundary conditions*
- *Analysis-oriented model for FRP tube-confined concrete: 3D interpretation of biaxial tube behaviour*
- *Strengthening RC beams with mid-span supporting prestressed CFRP plates: an experimental investigation*
- *Application of ultra-lightweight and large-scale pultruded for external frame beam in high-rise buildings*
- *A binary resin system of epoxy and phenol-formaldehyde for improving the thermo-mechanical behavior of FRP composites*

1 ENGINEERING DEMONSTRATION

- Pultruded GFRP external frame beam for high-rise building in Qingdao



IMPACT

This project tackled with typical problems encountered in practical applications of pultruded FRP composites. The research findings directly permit a breakthrough of the technological bottleneck of pultruded FRP composites. In particular,one demonstration project is conducted, and one design guide is established, which are to showcase the advantages and clarify the mechanics of pultruded FRP composites and their structures, and finally, to remove those concerns existing in the field and to promote pultruded FRP composites in the future.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2022 TDA 4-1
(JUL 2022 - JUN 2024)

Project Name: Development and demonstration of composite lattice tower for communication and power transmission over 15m

BACKGROUND

Traditional communication and power grid steel tower have the problems of difficult transportation and high transportation cost in remote mountainous areas, and composite material because of its excellent comprehensive performance, such as high strength, light weight, corrosion resistance, good insulation and other characteristics, communication and power industry in various countries to a high degree of attention. In special working conditions, composite lattice tower is a useful supplement to the existing communication and transmission tower.

AIMS AND GOALS

- To optimize the fiber and matrix materials for lattice towers, and reduce the total mass of lattice tower by ≥25% compared with metal one;
- To study composite lattice tower structures design, and reduce the use of metal connectors in lattice tower;
- To decrease single-piece mass of composite tower components, and enhance the connection strength.

PROJECT TEAM

哈尔滨玻璃钢研究院有限公司
Harbin FRP Institute Co.,Ltd.



PI: Sun Yunlong



INNOVATIONS

- GFRP materials with fiber volume content 68% were prepared by an injection pultrusion process using ECR9600-T911 glass fiber, isocyanate BM20 and polyether polyol urepul 2140P polyurethane resin as raw materials, with the tensile strength 1200 MPa, bending strength 1400 MPa, compressive strength 1000 MPa.

- The transverse tensile strength of composite lattice tower main beam and power transmission produced by pultrusion with full multi-axial cloth is more than 5 times higher than that produced by traditional pultrusion, the transverse bending strength is more than 6 times higher.

- Based on the analysis of the structural form and performance of composite joints, the composite structure with tenon-mortise structure and bolt fastening is designed, which is 10 times higher than the failure load of adhesive joints, the failure load is 2 times higher than that of bolt connection. Greatly improve the overall stability of the lattice tower.

- By using mechanical-free installation technology, the total installation period can be reduced from 7 to 5 days. The transportation and installation cost is reduced by 12.5% compared with that of the metal tower.

2 DEMONSTRATIONS

- FRP composite lattice tower built in Egypt and Guangzhou China

2 PAPERS

- *Comparative study on wind load design of communication lattice tower standard between Chinese, American and European*
- *Improving performance of GFRP joints using bolted/mortise-tenon hybrid method*

1 STANDARD

- Specification for manufacturing of composite lattice towers for communication'

1 PATENT

- A washboard corner composite profile, forming tooling and preparation method





IMPACT

As a substitution for steel, GFRP lattice tower avoids up to 35% CO_2 emission. Global demand of 5G facilities are soaring, GFRP promises substantial life-cycle carbon emission in telecommunication infrastructure. As the light weight, high strength and excellent weather resistance, GFRP composite products have greatly reduced the transportation and installation cost as well as the inspection and maintenance cost.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 80%

2022 PHD-1
(JUL 2022 - JUN 2024)

Project Name: High–modulus Elinvar glass fiber reinforce resin matrix composite engineering components

BACKGROUND

Fiber reinforced polymer (FRP) materials, with light-weight, high strength, corrosion resistance, and superior uni-directional mechanical properties along the fiber direction can effectively solve the problem of corrosion in civil engineering. However, the disadvantage of low modulus (only 70-75GPa) of the glass fiber reinforced polymers (GFRPs) produced from conventional glass fibers is prominent, and their modulus will further decrease with increasing temperature. How to solve this problem has become particularly important.

INNOVATIONS

- Through component design and optimization, oxide glass samples with strong Elinvar effect were prepared by melt quenching method;
- Conduct high-temperature modulus testing to establish the correlation between the Elinvar effect of oxide glass and glass composition.

AIMS AND GOALS

- To obtain the structural origin of the Elinvar effect in oxide glasses, and realize the controllable preparation of high-modulus oxide glasses with Elinvar effect and glass fibers;
- To dope SiO_2, TiO_2 or graphene into epoxy resin to achieve its toughening modification;
- To prepare the high-modulus GFRP with Elinvar effect by compounding the produced glass fibers and modified epoxy resin;
- To realize the integrated design of members and joints in truss structures of GFRP through optimized the connection efficiency of the components.

PI: Prof. Tao Haizheng
PhD student:
Zhou Hemin



武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY

IMPACT

The ultra-high-performance GFRP engineering components to be prepared can overcome the low modulus of the current commercial GFRPs, which can still maintain excellent mechanics in a corrosive environment, and its mechanical properties will be further improved as the temperature increases. In addition, effective methods to improve the connection efficiency of GFRP truss components will be proposed, which is of great significance to promote the wide application of GFRP in construction engineering.

INNOVATIONS

- The effects of nano-SiO_2 and graphene content on the mechanical and thermal properties of epoxy resin were systematically studied, including tensile modulus, elongation at break, coefficient of thermal expansion, thermal conductivity, and the optimal content was determined.
- The combined incorporation of kaolin and graphite into GFRP reduced the loss of room temperature flexural strength and increased the high-temperature residual flexural strength by over 100%.

1 PAPER

Pubulished in Ceramics International (SCI Q1)

Ceramics International 50 (2024) 33325–33332

Contents lists available at ScienceDirect

Ceramics International

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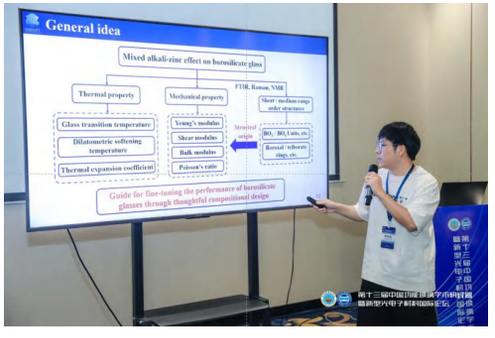
Impacts of substitution of alkali by zinc on thermo-mechanical properties in borosilicate glasses

Hemin Zhou [a,1], Guanzhou Xiao [a,1], Qingshuang Zheng [a], Ang Qiao [a,b], Haizheng Tao [a,*]

[a] State Key Laboratory of Silicate Materials for Architectures, Wuhan University of Technology, Wuhan, 430070, China
[b] Wuhan University of Technology Advanced Engineering Technology Research Institute of Zhongshan City, Zhongshan, 528437, China

2 CONFERENCE PRESENTATIONS

- The 13th China Functional Glass Academic Symposium and New Optoelectronic Materials International Forum
- The 22nd International Symposium on Non-Oxide and New Optical Glasses





IMPACT

From the perspective of the mechanical properties, thermal properties, and curing yield of the modified epoxy resin, it is difficult to meet the multiple performance requirements with a single nanoparticle modification.

Incorporating inorganic fillers is an effective method to improve the high-temperature residual strength of GFRP. This finding is crucial for enhancing the high-temperature resistance of GFRP and can effectively broaden its usable temperature range.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 80%

2023 TDA4-1
(JAN 2023 - DEC 2024)

Project Name: Preparation and application of FRP bent bar under corrosive environment

BACKGROUND

Corrosion of steel reinforcements in concrete structures that are explored to aggressive environments is one of the major factors that can render a structure structurally deficient before reaching the design service life. One alternative solution is the substitution of steel with fiber-reinforced polymer (FRP) bars. However, standardized, large-scale manufacture of three different types of stirrups (end-lap, closed and spiral stirrups) has not yet been well established. The mechanical behavior of stirrups and the shear/torsion failure mechanism of beams reinforced with FRP longitudinal bars and stirrups have not been investigated. Hence, further research is needed to provide technical support for the industrial production of FRP stirrups and their wide application in engineering structures.

PROJECT TEAM

同濟大學 TONGJI UNIVERSITY

湖南大學 HUNAN UNIVERSITY

江苏恒美德新材料有限公司 Jiangsu Chemlead New Material Co., Ltd.

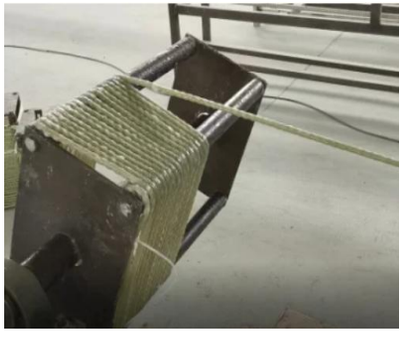


PI:
Prof. Jiang Jiafei

AIMS AND GOALS

- To develop 3 configuration-improved FRP stirrups, with the cost- effective and good mechanical performance;
- To establish the bend strength models for 3 stirrups considering creep fracture effect;
- To develop shear and shear-torsion design methods for FRP reinforced concrete members.





INNOVATIONS

- Developed the manufacturing technology for the end-lap stirrups, spiral stirrups, and closed stirrups.
- Propose the distribution model of bend strength retention rate for FRP stirrups, and the design value corresponding to specific guarantee rate.
- Conduct the creep test for FRP stirrups, and proposed calculation method for the creep strength and predicted creep rupture stress limit.
- Conduct shear tests on full-scale simply supported beams, and elucidated the contributions of shear-transfer mechanisms.
- Conduct torsion and torsion-shear tests on full-scale beams, revealed the torsional failure mechanism and reveal the shear-torsion interaction relationship.
- Conduct three demonstration projects including one oversea project, and extended the application to the laboratory structure for corrosion environment.

7 PAPERS

- *Shear behavior of two-span continuous concrete deep beams reinforced with GFRP bars*
- *Calculation approach for tensile strength of GFRP stirrup at bend based on database*
- *Strength retention rate distribution model and reliability analysis of FRP stirrups*
- *Transfer learning-based confinement strength prediction of concrete confined by FRP transverse reinforcements*
- *Flexural behavior and design of ultrahigh-performance concrete beams reinforced with GFRP bars*
- *Experimental investigation on pure torsion behavior of concrete beams reinforced with glass fiber-reinforced polymer bars*
- *A modified softened truss model and strength prediction formula for fiber-reinforced polymer reinforced concrete members under pure torsion*

1 DEMONSTRATION FRP Rebars Applied to Lach Huyen Port in Vietnam









1 STANDARD Group standard - 'Technical specification for non dismantling composite insulation external formwork system in shear wall structures

1 PATENT A device and process for producing FRP stirrups

IMPACT

- The solution of the key technology of FRP stirrup preparation forms a good industrial effect, which is conducive to promoting the standardised production and large-scale application of FRP, a green and low-carbon construction material (reducing 20% CO_2 emissions compared with steel).
- The proposed design method for FRP reinforced concrete beams provides technical support for the application of FRP stirrups in concrete structures and the draft of relevant design codes.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 80%

2023 TDA5-1
(JAN 2023 - DEC 2024)

Project Name: Fire endurance and creep resistance improvement for application of GFRP rebars

BACKGROUND

Glass fiber reinforced polymer (GFRP) has gained significant popularity in the domains of civil engineering, aerospace, and harbor engineering owing to its high specific strength, specific modulus, excellent corrosion and fatigue resistance, and low carbon emissions. However, despite these advantages, the application of GFRP bars in practical construction projects remains limited. This can be attributed to several factors, including the poor fire resistance of GFRP, incomplete investigation of its creep properties, and the limited availability of long-term design methods for GFRP reinforced concrete structures. It is imperative to address these challenges to promote the wider utilization of GFRP bars and associated structures.

AIMS AND GOALS

- To propose a novel technology for improving the fire resistance of GFRP reinforcement based on the degradation law of its tensile strength at high temperatures;
- To explore the degradation behavior of GFRP reinforced concrete components under fire conditions and establish a performance-based fire resistance design method;
- To propose a technology for improving the creep performance of GFRP based on the influence law of its creep fracture performance.

PROJECT TEAM

泰山玻璃纤维有限公司
Taishan Fiberglass Inc.

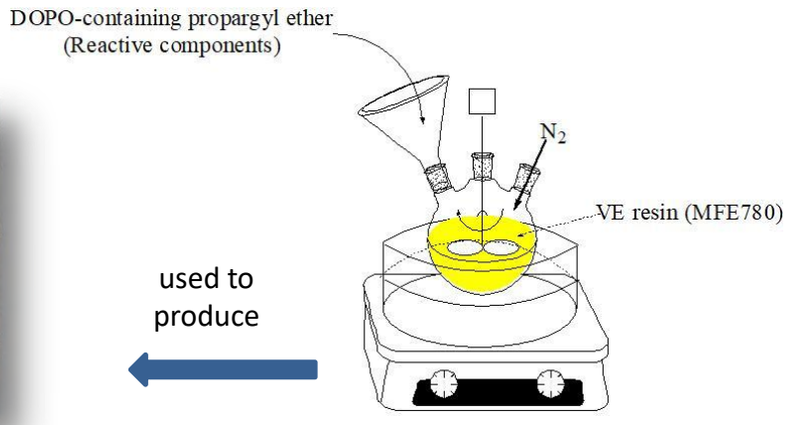
中复碳芯电缆科技有限公司
ZHONGFU CARBON CORE CABLE TECHNOLOGY CO., LTD



PI: Dr. Hu Lili







1 PAPER

- *Long-term behavior of high performance GFRP bars, international conference on advances in engineering and technology for sustainable development*

1 PATENT

- Modification of vinyl ester resin and preparation method thereof

INNOVATIONS

- Developed a modified vinyl ester resin with improved property by blending phosphorus and flame retardants. The modified resin is then used as one of the material to manufacture GFRP rebar.
- The proposed GFRP rebar achieves and exceeds the target of 45% tensile strength retention at temperature 400℃, with 68%.
- In terms of fire resistance of GFRP RC member, clarified a general trend of thicker concrete protection layer can improve the fire resistance of structure. In addition, under the same volume, increasing the length of fire retardant (applied on edge of member) is more effective than increasing the thickness.

IMPACT

This project focuses on the development of a next-generation glass fiber-reinforced polymer (GFRP) bar, which boasts excellent mechanical properties, high-temperature resistance, superior creep resistance, and excellent corrosion resistance. These attributes significantly extend the service life of structures while minimizing maintenance requirements. A major impact of GFRP bars is their lower energy consumption and reduced carbon emissions during production compared to traditional steel bars. Life cycle analysis indicates that GFRP bars reduce CO_2 emissions by at least 17% over their entire life cycle compared to conventional steel reinforcement. Furthermore, due to their superior mechanical performance, the quantity of GFRP bars required in construction can be reduced, potentially leading to even greater reductions in CO_2 emissions. Beyond environmental benefits, GFRP bars also offer significant cost savings. The use of GFRP bars can result in initial cost savings of approximately 19-23%, with potential savings reaching up to 40% over the lifespan of the structure. Moreover, the lightweight nature of GFRP bars simplifies transportation, construction, and installation processes, further reducing construction costs and enhancing project efficiency. This innovative material represents a sustainable and cost-effective solution for modern construction challenges.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED / 100%

2023 SFP 2-1
(JAN 2023 - JUN 2024)

Project Name: Standardization of product properties for continuous fiber reinforced thermoplastic resin composite rebars



PI: Prof. Xian Guijun

BACKGROUND

The lack of product standard or test method for continuous fiber reinforced thermoplastic resin based composite bars limits their industrial development and engineering applications. The preparation method, composition, performances and engineering application methods of thermoplastic rebars are quite different from those of thermosetting ones, and the existing standards for thermosetting bars cannot be directly used for thermoplastic ones. The standardization of thermoplastic rebars will be the key to promote their large-scale applications.

AIMS AND GOALS

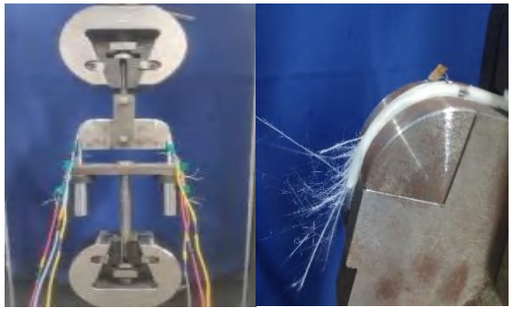
- To formulate product or testing standards for thermoplastic rebars;
- To obtain physical mechanical and hot bending properties of thermoplastic rebars;
- To obtain basic performance indicators of thermoplastic rebars.

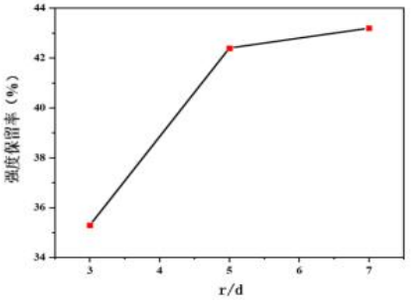


哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY

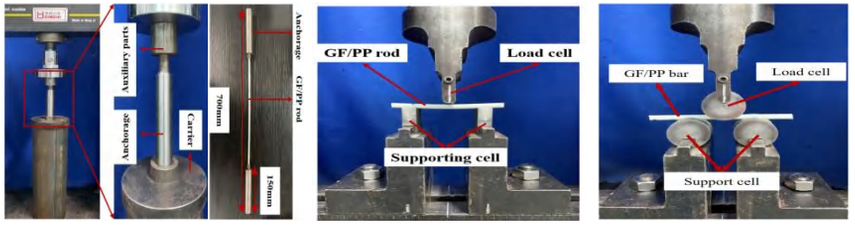
INNOVATIONS

- The physical and mechanical properties of three kinds of thermoplastic composite bar are obtained.
- Bending device of thermoplastic composite bar is developed, the test method and verification data of thermal-bending performance for thermoplastic composite bar are obtained.
- The standardization of continuous fiber reinforced thermoplastic composite products and testing methods has been carried out, and the standard of 'Thermoplastic Fiber-reinforced Polymer Composite Bars' has been published





Thermal-bending property and verification data of thermoplastic composite bar



Tests and performances of thermoplastic composite bar

Performances	GFRPP	CFRPA6	GFRPM
Tensile strength/MPa	887.2±36	2934±58	1233.4±16.1
Tensile modulus/GPa	34.8±0.6	142±2	58.9±1.5
Flexural strength/MPa	750±118	814±78	826.8±126.8
Flexural modulus/GPa	20±2.7	90.6±4.5	25.6±0.9
Shear strength/MPa	24.9±1.24	35.5±3.3	29.1±4.4

STANDARD: Thermoplastic Fiber-reinforced Polymer Composite Bars



ICS 93.080.30
CCS P 66

团 体 标 准

T/CECS ××××—20××

热塑性纤维增强复合材料筋

Thermoplastic Fiber-reinforced Polymer Composite Bars

2024-12-06 发布　　2025-05-01 实施

中国工程建设标准化协会 发布

IMPACT

- The product standard of continuous fiber-reinforced thermoplastic polymer composite bars has been established, which can solve the problem of performance testing and evaluation of thermoplastic composite bars, and to fill the gap in China.
- The research results of project serves the major national strategic of engineering construction, which promotes the development of technical level and market application of thermoplastic composites bars in civil engineering.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED /100%

2023 PHD-1
(JAN 2023 - DEC 2024)

Project Name: CFRP prestressed concrete assembled raft-type floating structures

BACKGROUND

The construction of offshore structures used for energy development, fishery and tourism can expand the space and promote ocean economic development. The traditional way to transfer sea to land is land reclamation, but it causes huge damage for the local environment. Compared to onshore construction, offshore construction faces many disadvantages: harsh corrosion environment, complex loading condition, and limited maintenance capacity. Therefore it is necessary to develop new offshore structures with new materials, such as FRP composites.

AIMS AND GOALS

- To design a new concrete floating platform for the marine environment;
- To establish a prediction model for CFRP stress corrosion;
- To propose a design method for CFRP prestressed concrete assembled raft-type floating structures;
- To promote the use of petroleum-based materials in marine structure and large-scale offshore infrastructure construction.

清華大學 土木水利学院
SCHOOL OF CIVIL ENGINEERING
TSINGHUA UNIVERSITY



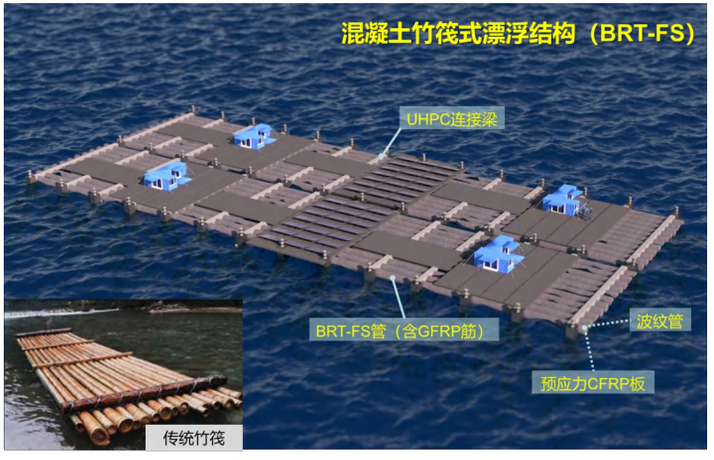
PI: Prof. Feng Peng



PhD Student: Xie Chongfeng

INNOVATIONS

- Inspired by bamboo rafts, a novel BRT-FS assembled by FRP reinforced concrete tubes is proposed, which has good designability and construction efficiency due to its unique structural design.
- The durability is improved by the addition of two corrosion-resistant materials, concrete and FRP. The bearing and buoyancy functions are separated to further increase the durability of the structure and ease structural design.



2 PAPERS

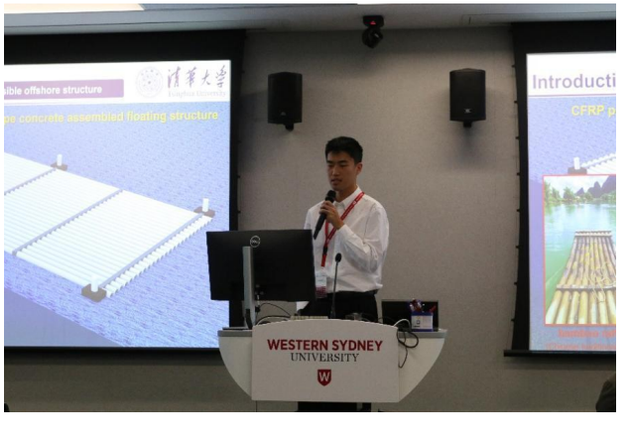
- *Novel bamboo-raft-type floating structure (BRT-FS) assembled by FRP reinforced concrete tubes: conceptual design and analysis*
- *Mesoscale simulation method for preplaced aggregate concrete based on physics engine*

1 PATENT

- Raft-type platform with photovoltaic and wave power generation system

1 CONFERENCE PRESENTATION

- The 4th International Symposium for Emerging Researchers in Composites for Infrastructure



IMPACT

The research results of stress corrosion of CFRP can be used to guide its application in harsh corrosion environment, improve the structural performance in extreme environment, and expand the market demand of CFRP. The concept design of bamboo raft floating structure can guide the construction of marine infrastructure, promote the economic development of coastal areas, and further promote the application of high-durability materials such as fiber reinforced polymer in marine engineering.

Fibers, Rebars, and Fiber Composites (FRPs)

COMPLETED /100%

2023 PHD-8
(JAN 2023 - DEC 2024)

Project Name: Research on fatigue-creep coupling behavior of glass-fiber reinforced resin matrix composites

BACKGROUND

There are many bridges that have been in use for a long time and the bridge deck is one of the most frequently and critically damaged components. The severely damaged bridge deck must be replaced. Glass fiber reinforced polymer (GFRP) composite has the advantages of light weight, high strength, corrosion resistance, which can be used to replace the damaged bridge deck. However, creep significantly affects the micro-crack aggregation, interface fatigue failure and fiber fatigue fracture of GFRP material under fatigue loading, and the mechanism of fatigue-creep coupling is complex. The existing design methods have insufficient understanding of the fatigue-creep coupling mechanism of GFRP and lack of effective evaluation methods, which has become a bottleneck for the application of GFRP materials in bridge engineering.

AIMS AND GOALS

- To study the influence of creep on the fatigue performance of GFRP structure under high stress level and the influence mechanism of creep on the fatigue time-dependent performance of pultruded GFRP material;
- To establish an accurate and reliable multi-scale numerical simulation method for fatigue-creep coupling time-dependent performance of GFRP materials;
- To predict the evolution law of stiffness and creep deformation of bridge GFRP structure under complex load.

西安交通大學
XI'AN JIAOTONG UNIVERSITY

PI: Prof. Xin Haohui





Ph.D Student: Gao Qinlin

INNOVATIONS

- A series of prediction models were established to describe the fatigue life, energy dissipation capacity and cyclic creep strain.
- An analytical model was proposed to predict fatigue crack propagation in center cracked plate strengthened with FRP strip.
- The fatigue damage process and mechanism of the web-flange junction were deeply explored.

3 PAPERS

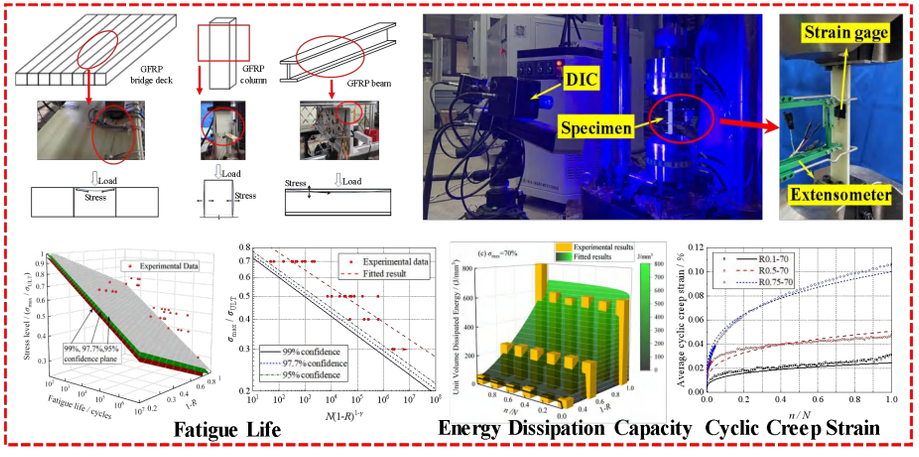
- *Experimental investigation on transverse tension-tension fatigue behavior of pultruded glass-fiber reinforced polymer (GFRP) unidirectional lamina*
- *Probabilistic fatigue stiffness variation of angle-ply GFRP composites considering stress ratio effect*
- *Prediction of fatigue crack propagation in center cracked steel plate strengthened with partially covered CFRP strip*

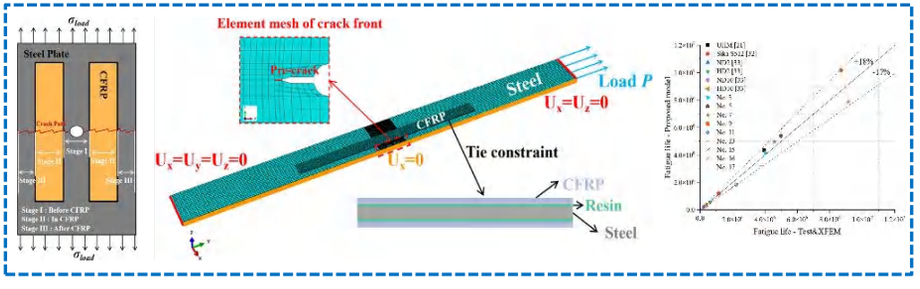
1 CONFERENCE PRESENTATION

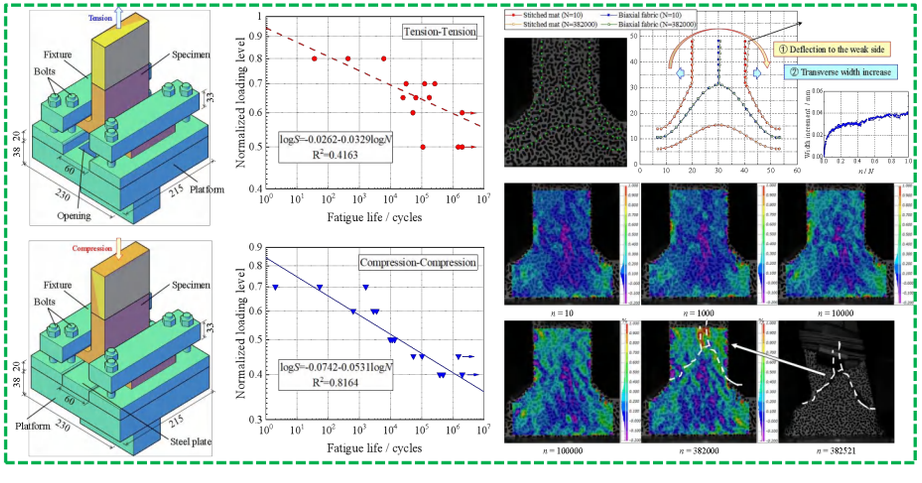
- “Research on axial fatigue behavior of web-flange junctions of pultruded GFRP profile” in ICCS26 & MECHCOMP8

IMPACT

Economically, it reduced costs by providing theoretical support for the rational design of GFRP structure durability, which can decrease expenses related to frequent maintenance and replacement of structures. Socially, its successful implementation can lead to more reliable infrastructure (such as bridges, buildings, and pipelines), improving public safety and well-being. In terms of carbon reduction, GFRP materials generally have a longer service life compared to some traditional construction materials.







Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 50%

2024 TDA-1
(JAN 2024 - DEC 2025)

Project Name: Fiber reinforced concrete and its surface strengthening for novel transportation infrastructure

PI: Prof. Long Guangcheng

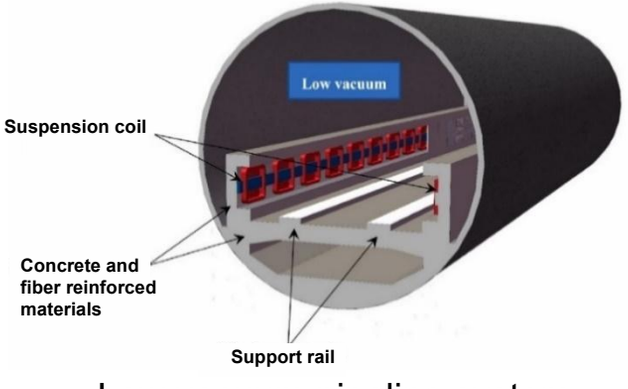


BACKGROUND

The low-vacuum magnetic levitation transport system operates in a challenging environment, where the concrete structure is exposed to low vacuum, pressure variations, and high temperatures. These factors present significant challenges to the long-term safety and performance of the system. Additionally, the issue of electromagnetic interference from steel reinforcement to the magnetic levitation system requires urgent resolution. It is necessary to develop high-performance special concrete and surface reinforcement technologies targeted for this system.

AIMS AND GOALS

- To understand the performance evolution mechanism of concrete, non-metallic fiber and coating materials suffering low-vacuum;
- To develop high performance special concrete by employing non-metallic petroleum-substrate fiber reinforcement system;
- To innovate high quality petroleum-substrate coatings for concrete surface reinforcement in new transport infrastructure such as ultra-high speed low vacuum pipeline system.



Low vacuum pipeline system

PROJECT TEAM

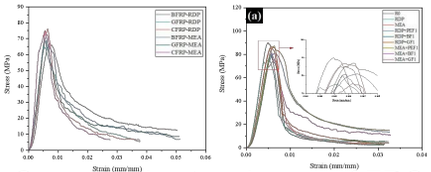
中南大學
CENTRAL SOUTH UNIVERSITY

中铁工程设计咨询集团有限公司
China Railway Engineering Design and Consulting Group Co.,Ltd.

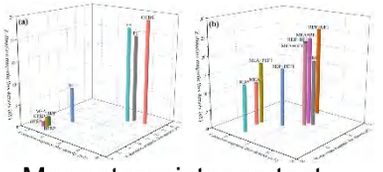


INNOVATIONS

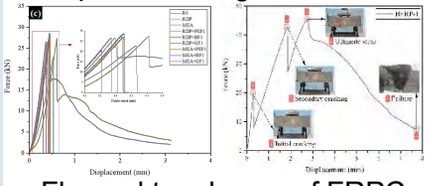
- Propose a design and preparation method for low magnetic resistance, high toughness and high durability special concrete suitable for low vacuum pipeline structures.
- Simulates the service environment of low vacuum pipelines, reveal the influence patterns and mechanisms of low vacuum environments on concrete performance.
- Utilize hydrocarbon-based polymers, non-metallic fibers, and FRP toughening materials to improve the long-term service stability of concrete and reduce the magnetic resistance during train operations.
- Design a device to capture dust released in low vacuum environments, investigate the causes of dust release, and explore dust suppression measures.



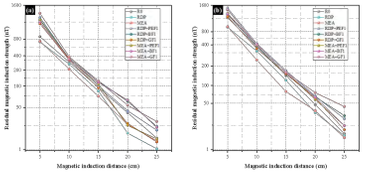
Compressive toughness of FRC



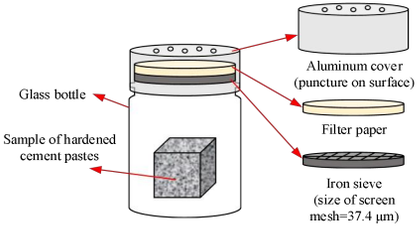
Magnetoresistance test



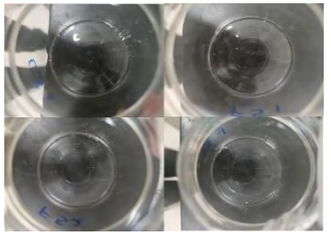
Flexural toughness of FRPC



Residual magnetic induction

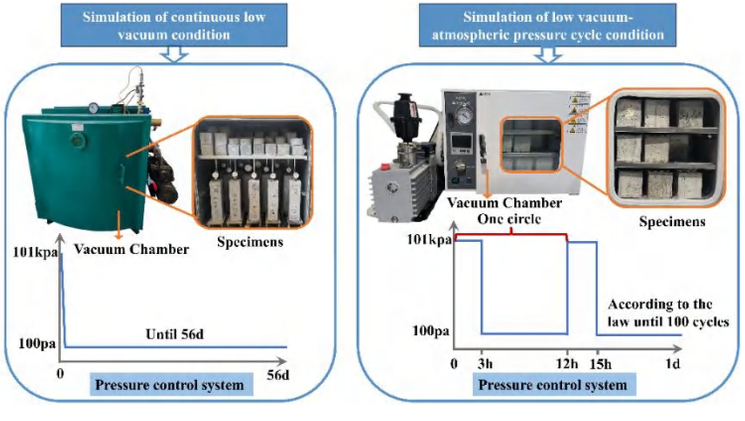


Dust capture device



Dust capture results

1 PATENT A highly stable concrete in low vacuum tube environments and its preparation method



Low vacuum pipeline environment simulation

IMPACT

- The durability and operational stability of low-vacuum pipeline structures can be greatly enhanced through fiber and FRP reinforcement techniques, providing critical material and technical support for the construction of new transportation infrastructure.
- The designed special concrete uses redispersible latex powder, modified emulsified asphalt, polyethylene fibers, and FRP, which not only enhance the performance of the concrete but also promote the high-value utilization of petroleum-based materials, and reduce CO_2 emissions.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 75%

2024 SFP-2
(JAN 2024 - JUN 2025)

Project Name: Application and demonstration of FRP tube - concrete new composite structure

BACKGROUND

In response to the issues of shear failure in the core area of traditional reinforced concrete frame joints and the difficulties in construction due to dense reinforcement in the joint area, this project proposes a new type of composite joint, namely the FRP tube-concrete combination joint. The construction of the new joint is more convenient, improving construction efficiency and facilitating the development of green and modular construction in joint structures.

PROJECT TEAM

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

CityU 香港城市大學 City University of Hong Kong

中国建筑第八工程局有限公司 CHINA CONSTRUCTION EIGHTH ENGINEERING DIVISION CORP., LTD

AIMS AND GOALS

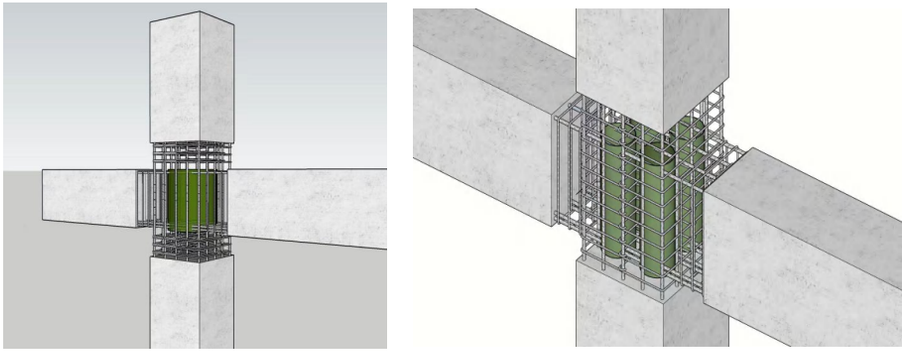
- To establish design methods for the axial compression performance of FRP tube-concrete composite columns.
- To clarify the key construction and construction techniques of FRP tube-concrete composite joints and conduct engineering.
- To develop calculation methods for the shear capacity and seismic performance of FRP tube-concrete composite joints.



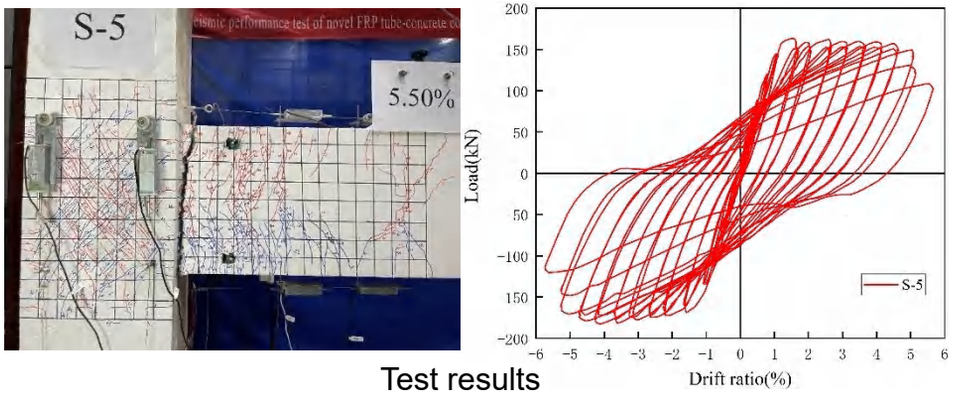
Prof. Bai Yulei

INNOVATIONS

- Developed a novel type of composite joint, namely the FRP tube-concrete composite joint with the follow merits: (1)The FRP tube provides confinement to the core concrete, enhancing the shear capacity of the joint; (2) It may eliminate the need for dense reinforcement in the joint zone, improving construction efficiency and facilitating the development of green and modular construction in joint structures.
- Conducted 10 large scale FRP tube-concrete composite joint tests. The stress development and distribution of the FRP tube, column bars, and stirrups in the core area of the joint was analyzed.
- Field application demonstration of this novel FRP tube-concrete composite joint was conducted in a construction site, Lize Financial Business Area, located in Fengtai District, Beijing.



Innovative FRP-tubed concrete joint



Test results

IMPACT

This project solves the shear failure problem in the core area of traditional reinforced concrete frame joints and the difficulties in construction due to dense reinforcement in the joint area. Results showed that failure in the joint zone is completely avoided with sufficient shear capacity, and a new design method based on FRP tubed-concrete joint is to be established. This project pushes the practical application of non-metallic materials like FRP in new construction,and provide a new choice for joint type in seismic regions.



Field application

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 75%

2024 SFP-4
(JAN 2024 - JUN 2025)

Project Name: Research and demonstration on the performance of thermoplastic FRP stirrup

PI: Dr. Li Chenggao



BACKGROUND

Fiber reinforced thermoplastic composite bar has the advantages of repeated molding, high toughness/durability and recyclability. The bending process and forming method of thermoplastic composite bar are the key to preparing the concrete stirrups. At present, there is a lack of efficient bending devices for thermoplastic stirrups. In addition, the technologies for improving the mechanical properties of thermoplastic composite stirrups and the design methods of concrete structures are key to promoting the demonstration application of marine engineering.

AIMS AND GOALS

- To develop a bending device and forming method for thermoplastic stirrups that meet the rapid bending needs on site;
- To reveal the formation mechanism of fiber dislocation, crack defect of thermoplastic composite stirrups;
- To establish a theoretical calculation model for the bending strength of thermoplastic composite stirrups.

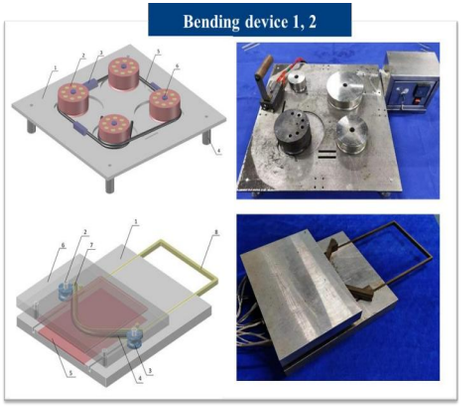
PROJECT TEAM

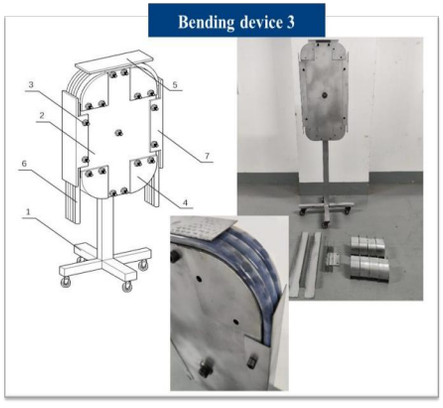
哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY



INNOVATIONS

- A low-cost and high-efficiency thermoplastic stirrup bending device and a forming method are developed, which meet the requirements of rapid bending on site.
- The influence mechanism of different bending radius and bar diameter on the bending strength of stirrups was revealed.
- The improvement method of mechanical properties of thermoplastic composite stirrups based on material modification and bending process optimization is proposed.



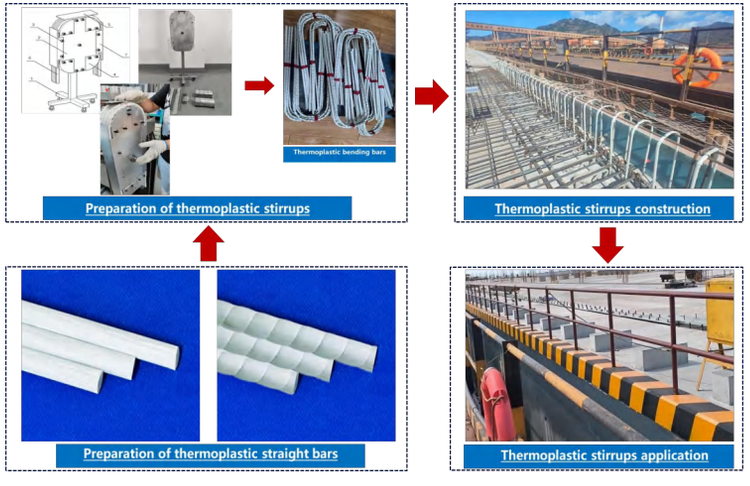


1 ENGINEERING DEMONSTRATION

- Demonstration application of thermoplastic composite bending bars in wharf structure in Fuzhou Port Luoyuanwan Port Area

3 PATENTS

- Fiber reinforced thermoplastic stirrup bending device and method
- Bending forming device and method of thermoplastic fiber reinforced composite stirrup
- A bending device and method



4 PAPERS

- *Design, preparation and mechanical properties of novel glass fiber reinforced polypropylene bending bars*
- *Long-term properties evolution and life prediction of glass fiber reinforced thermoplastic bending bars exposed in concrete alkaline environment*
- *Study on the durability of compression behavior for glass fiber-reinforced polypropylene thermoplastic composite bars in various aging environments*
- *Design, preparation, and mechanical properties of glass fiber reinforced thermoplastic self-anchor plate cable exposed in alkaline solution environment*

IMPACT

Compared with steel bars, thermoplastic bars significantly reduce carbon emissions and energy consumption during manufacturing. Weighing about half that of steel bars, thermoplastic stirrups greatly decrease the dead weight of structures, further saving resources and reducing carbon emissions by minimizing operational and maintenance times over their lifespan. A life cycle analysis over a 100-year design life indicates that the cost savings per ton of thermoplastic stirrups can reach as high as 23.79% compared to steel bars, highlighting their remarkable economic benefits.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 50%

2024 PHD-4
(JAN 2024 - DEC 2025)

Project Name: Synthesis of phosphorus-containing metal-imidazole complex flame-retardant latent curing agents and their effect on the curing, flame retardancy and smoke suppression properties of epoxy resin

BACKGROUND

How to simultaneously achieve excellent flame retardancy, smoke suppression, overall performance, as well as long-lasting latency and rapid curing is a challenging issue in the field of epoxy resin applications. To address this, the project aims to molecularly design and synthesize a class of phosphorus-containing metal-imidazole complex curing agents through intrinsic flame retardant technology, smoke suppression technology, and latent fast-curing technology in the organic combination of modified curing agents. This work provides valuable insights for the design and preparation of high-performance single-component epoxy resin systems.

AIMS AND GOALS

- To explore new methods for the molecular design and synthesis of imidazole-based curing agents with metal ions and phosphorus-containing groups;
- To obtain a multifunctional curing agent that integrates "long-lasting latent, rapid curing, and efficient flame retardant and smoke suppression" characteristics;
- To open up new pathways for the design and preparation of high-performance single-component epoxy resin systems.

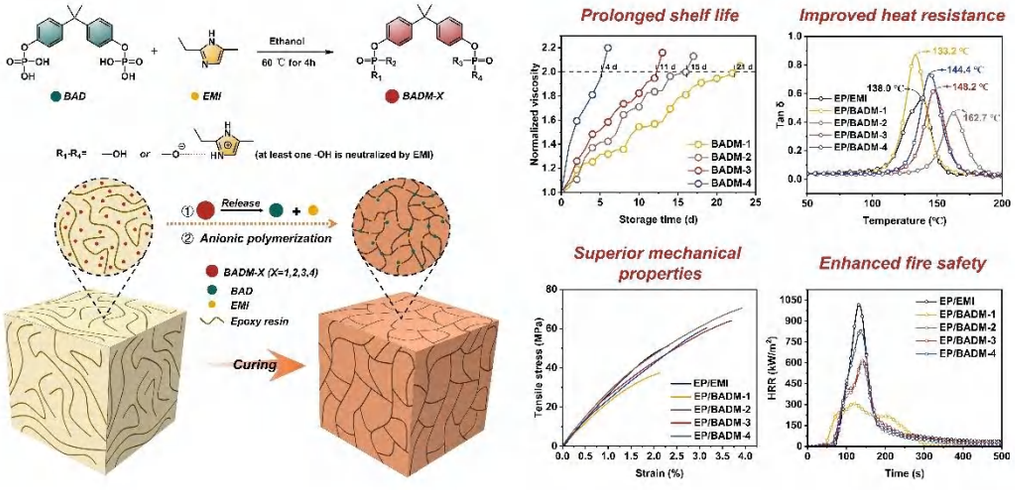
武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY

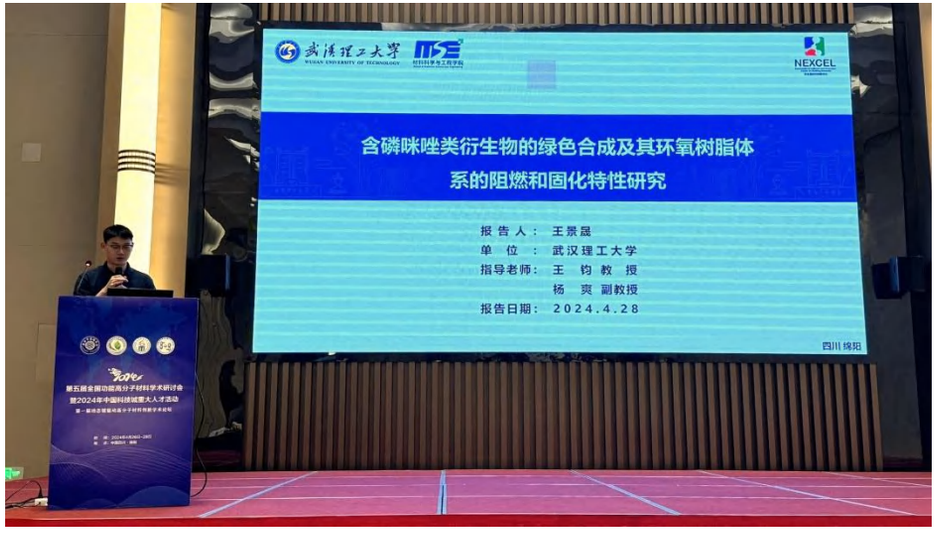


PhD Student: Wang Jingsheng

INNOVATIONS

- A series of phosphorus-containing imidazolium compounds were synthesized as multifunctional latent hardeners for one-component epoxy resins.
- The impact of the phosphorus-to-imidazole ratio in imidazolium salts on the latent reactivity, thermal stability, and mechanical properties of epoxy resin systems was systematically studied.
- A flame-retardant and smoke-suppressant latent curing agent for epoxy resins was created by incorporating phosphorus groups and metal ions into the imidazole structure





2 PAPERS

- *Multifunctional phosphorus-containing imidazoliums endowing one-component epoxy resins with superior thermal latency, heat resistance, mechanical properties, and fire safety*
- *Development of single-component epoxy resin with superb thermal stability, flame retardancy, smoke suppression, and latency via Cu-based phosphorus/imidazole-containing complex*

1 CONFERENCE PRESENTATION

- Green synthesis of phosphorus-imidazole derivatives and their flame retardant and curing properties in epoxy resin systems

IMPACT

This project develops a series of phosphorus-containing imidazole derivatives as a single-component epoxy curing agent, integrating flame retardancy and smoke suppression to significantly enhance fire safety. By replacing conventional two-component systems, it streamlines industrial logistics while reducing toxic emissions during combustion, aligning with eco-friendly manufacturing. The technology provides scalable, high-performance solutions for construction and electronics, mitigating fire hazards and environmental impacts, thereby promoting sustainable development in polymer materials.

Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 50%

2024 PHD-5
(JAN 2024 - DEC 2025)

Project Name: Research on multifunctional carbon fabric reinforced seawater sea-sand concrete composite member system

BACKGROUND

The durability issue of existing reinforced concrete structures is becoming increasingly urgent, and there is a shortage of freshwater river sand resources for new concrete projects. Based on carbon fiber's dual functions of reinforcement and self-sensing, the development of a multifunctional carbon fabric reinforced seawater and sea-sand concrete composite member system (ICCP-SS-SHM) that combines impressed current cathodic protection, structural strengthening, and structural health monitoring, can achieve construction informatization and intelligence, avoid sudden accidents in structures, and has a significant meaning.

浙江大学 ZHEJIANG UNIVERSITY

AIMS AND GOALS

- To improve the bonding performance between carbon fabric and mortar to enhance mechanical performance of the composite;
- Applying ICCP to prevent steel corrosion in structures and promoting seawater and sea sand usage to address river sand scarcity;
- Utilizing fabric modification, piezoresistive effect, and ICCP to create a multifunctional structural system for cathodic protection, structural strengthening, and health monitoring, advancing construction industry intelligence.



PhD Student: Liu Jiarong

INNOVATIONS

- Prediction formulas for bond performance were established based on the charge densities, mechanical parameters, and resistance parameters. The effect of ICCP on the piezoresistive effect was analyzed.
- By observing the piezoresistive effect , the sequence of crack propagation and an approximate crack location can be inferred.
- An equivalent model was developed to accurately evaluate the piezoresistive response and failure processes of CFRCM.

4 PAPERS

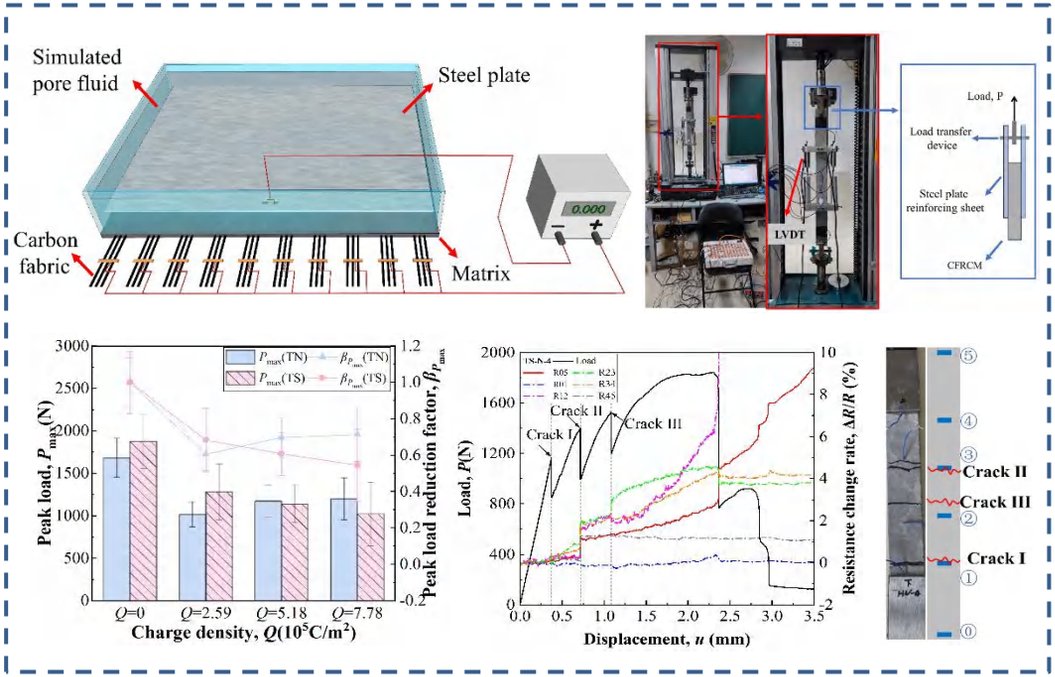
- *Effect of ICCP on tensile performance of carbon fiber bundles in seawater sea-sand cementitious matrix*
- *Effect of ICCP on bond performance and piezoresistive effect of carbon fiber bundles in cementitious matrix*
- *Effect of ICCP on tensile performance and piezoresistive effect of CFRCM plate*
- *A Pull-out equivalent telescopic layered failure model of carbon fiber bundles in seawater sea-sand cementitious matrix*

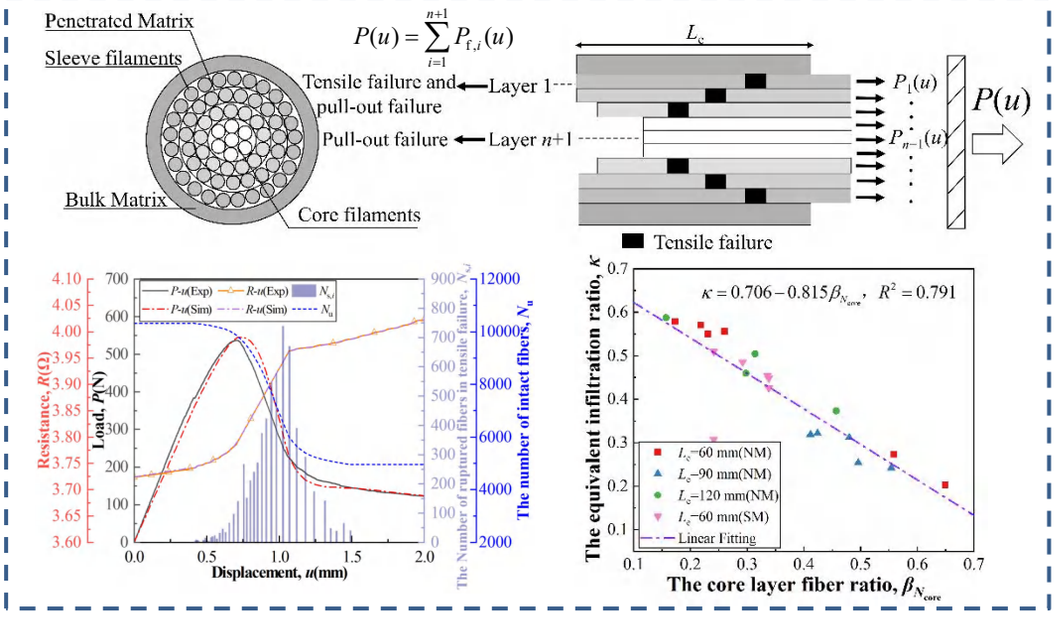
1 CONFERENCE PRESENTATION

- “Electrical conductivity and piezoresistive response of CFRCM with ICCP” in the 10th Conference of the ACF

IMPACT

This study can promote the large-scale utilization of seawater and sea sand resources as well as the informatization and intelligent development of construction projects. It can also reduce property losses and casualties caused by sudden structural failures.





Fibers, Rebars, and Fiber Composites (FRPs)

ONGOING / 50%

2024 PHD-6
(JAN 2024 - DEC 2025)

Project Name: Ultimate and serviceability limit state design for FRP-UHPC hybrid beams

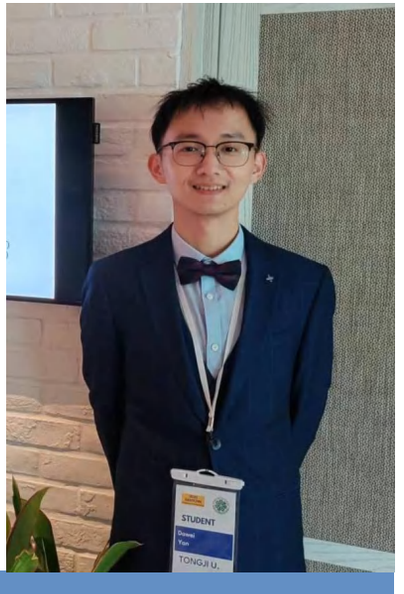
BACKGROUND

The deterioration of steel-concrete composite structures due to corrosion of structural steel and concrete degradation affects the durability and safety of the structures. UHPC and FRP are two promising alternation to concrete and steel, respectively. FRP-UHPC hybrid beams are a novel type of composite beams, and have the advantage of light weight, high strength, excellent durability, environmental friendly and rapid construction, but research on them is still scarce, which restricted the widespread application.

同济大学
TONGJI UNIVERSITY

AIMS AND GOALS

- To investigate shear behavior of GFRP bolts to provide calculation method for shear bearing capacity and shear-slip model;
- To propose the creep and shrinkage model of UHPC under room temperature curing;
- To propose the ultimate and serviceability limit state design method for FRP-UHPC hybrid beams.



PhD Student: Yan Dawei

INNOVATIONS

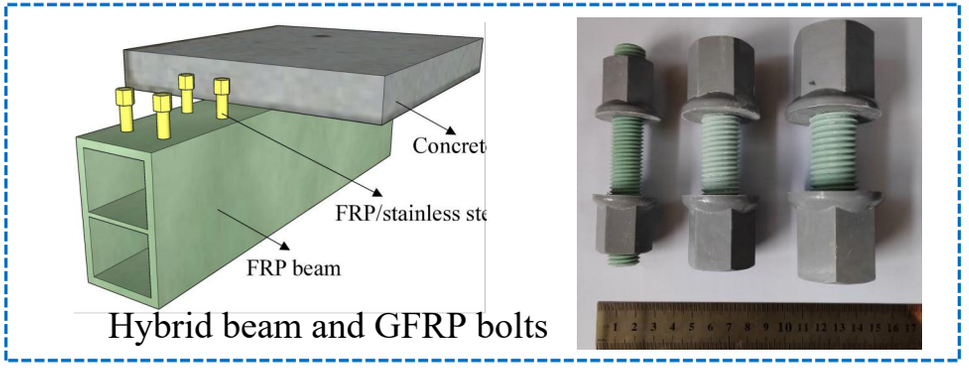
- To solve the steel corrosion and concrete deterioration in steel-PC composite beams, a novel type of FRP-PC hybrid beam has been proposed by replacing steel girder, steel strands, steel connectors, and concrete with GFRP profiles, CFRP tendons, GFRP bolts, and UHPC respectively.
- The shear behavior of bolt shear connectors made of FRP was investigated.
- A numerical investigation and parametric analysis on the static behavior of FRP-PC hybrid beams with partial connection was developed.
- A FE model on the time-dependent behavior of FRP-PC hybrid beams considering the temperature changes was developed.

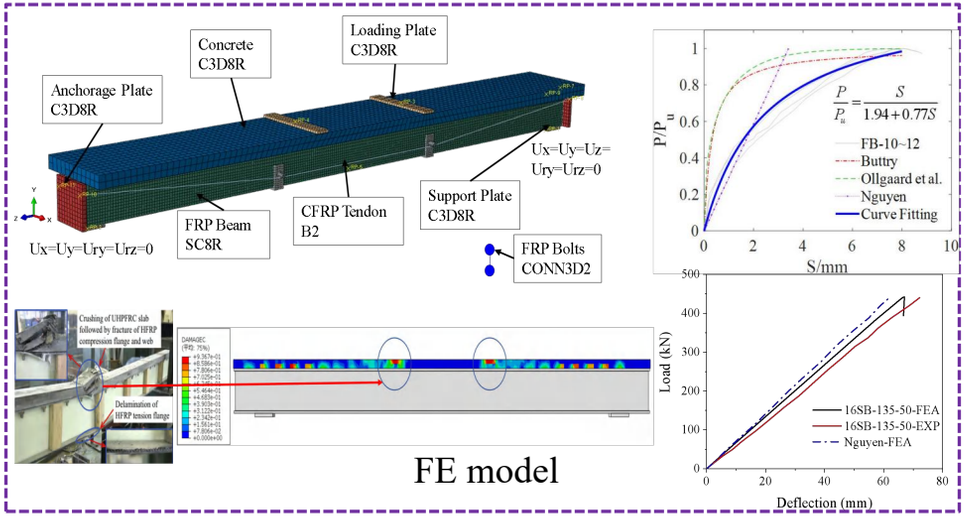
1 PAPER

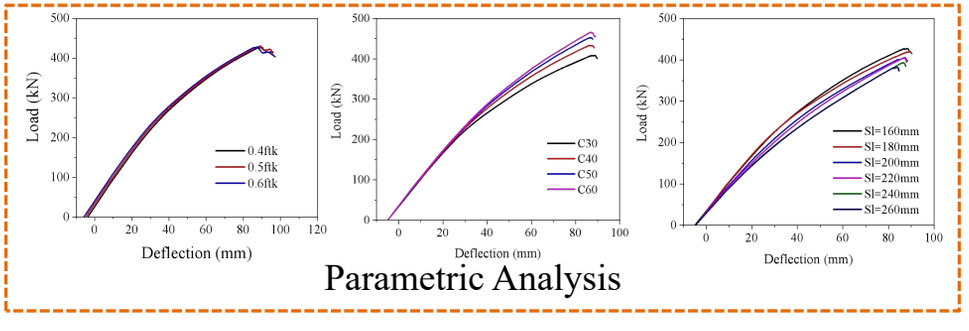
- *Effect of shear connection degree on static behavior of externally prestressed FRP-concrete hybrid beams: experimental and numerical study*

IMPACT

FRP-UHPC hybrid beams have advantages of lightweight, high-strength, rapid construction and durable characteristics, which enhance infrastructure safety and longevity while reducing project timelines and maintenance costs. The research results will provide a basis for the wide application of FRP-UHPC hybrid beams in bridge engineering.



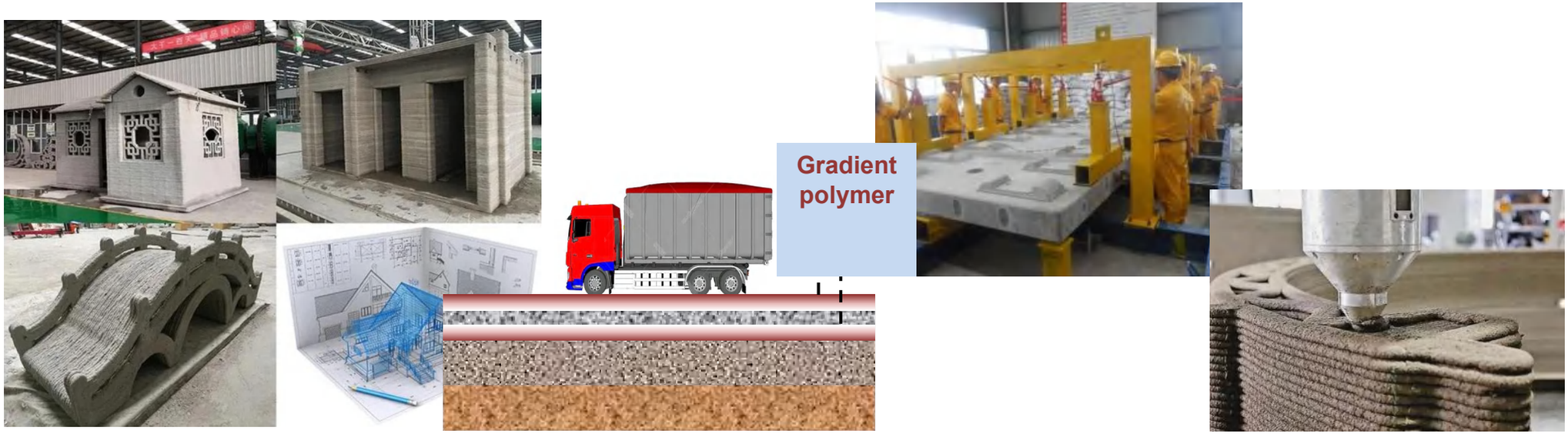






Special Mortars & Concrete

Projects on Special Mortars & Concrete		
1	22 SFP1-1	Research on 3D printed polymer modified concrete and its interface enhancement technology
2	22 SFP5-1	Study on key technology of polymer modified inferior coarse aggregate
3	23 TDA1-1	Develop hydrocarbon-based graphene for improving properties of concrete
4	23 TDA6-2	Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete
5	23 PHD-6	Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials
6	24 PHD-8	Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization
7	24 PHD-9	Preparation of railway sleeper using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties
8	24 PHD-10	Preparation and mechanism of carbon black/cementbased electromagnetic wave absorbing materials with multimechanism



Special Mortars & Concrete

COMPLETED / 100%

2022 SFP 1-1
(JUL 2022 - JUN 2023)

Project Name: Research on 3D printed polymer modified concrete and its interface enhancement technology



PI: Prof. Wang Zhendi

BACKGROUND

Concrete 3D printing enables quick and efficient completion of automatic construction of buildings. However, ordinary concrete can hardly meet the requirements of 3D printing owing to poor printability and buildability of fresh slurries. Moreover, weak bonding interface between filaments highly limits the development and application of 3D printing concrete. All these challenges may be addressed by the continually developed petroleum based products, and promote the coordinated development of concrete 3D printing and petroleum-based polymer applications.



AIMS AND GOALS

- To improve the printability of 3D printing concrete by using polymer emulsion, polyacrylamide and hydroxymethyl cellulose;
- To improve the toughness, ductility and deformability of 3D printing concrete by using polymer fibers in concrete matrix;
- To develop a polymer emulsion spraying system in synchronization during concrete 3D printing, increasing the interface strength of concrete;
- To design and manufacture a novel nylon-based saddle stitching nails reinforcement for 3D printing concrete.

PROJECT TEAM

浙江大学 ZHEJIANG UNIVERSITY

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

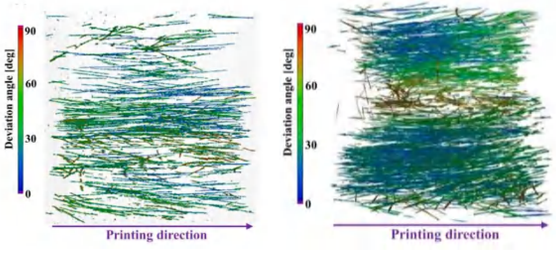
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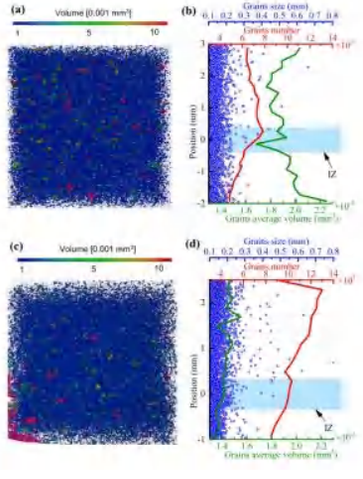
INNOVATIONS

- 7.5% dosage of petroleum-based polymer emulsion improved the rheology and printability properties of cement based materials;
- 0.6% dosage of polyethylene fiber improved the toughness of 3D printing concrete, with fibers exhibiting aggregation and vertical printing direction distribution in the interlayer area, and fibers exhibiting dispersion and parallel printing direction distribution inside the matrix;
- Application of 2% nylon-based (Polyamide, PA) saddle stitching nails reinforcement technology for 3D printing concrete was greatly promoted.

3 PAPERS

- *Differences in micro grainfiber distributions between matrix and interlayer of cementitious filaments affected by extrusion molding*
- *Gradient distribution of slender glass microfibers in 3D printed cementitious filaments*
- *Rebar-matrix interface in extrusion molded cementitious filaments*





2 PATENTS

- Micro vibration method and 3D printing of concrete components
- Preparation method and application of polymer emulsion

1 STANDARD

- Test method for interfacial bonding strength of 3D-printed cement-based materials

1 DEMONSTRATION

- 3D printing polymer modified concrete for landscape water wall



IMPACT

The findings and techniques developed will overcome the limitations of ordinary 3D printing concrete materials with fragile matrix, weak bonding strength, and anisotropic structure, and achieve the reinforcement and toughening of 3D printing concrete with petroleum-based polymer materials. The innovations of materials and techniques can provide solid supports for promoting the applications of petroleum-based polymers in building materials and civil engineering, plays an important leading role in promoting the application of petroleum-based polymers in housing, bridges, gardens and municipal engineering, and would open a gate to large-scale uses of petroleum products in construction and building industry with significant economic and social benefits.

Special Mortars & Concrete

COMPLETED / 100%

2022 SFP 5-1
(JUL 2022 - JUN 2023)

Project Name: Study on key technology of polymer modified inferior coarse aggregate

BACKGROUND

At present, the global consumption of coarse aggregate for motar and concrete is still growing, but the high-quality resources are diminishing. In some islands and coastal areas, common coarse aggregate resources are scarce. Meanwhile, inferior coarse aggregate or coral reefs are widely distributed on tropical coasts and islands, but it can't be used largely for the lack of technology. If the inferior coarse aggregate could be treated and reused, which can reduce the over-dependence on natural mineral resources and carry out green and sustainable development.







Inferior coarse aggregate



Polymer modified inferior coarse aggregate

AIMS AND GOALS

- To select the optimal polymer emulsion and reactive powder concrete materials.
- To improve the application performance and meet the requirements by using the polymer modified inferior aggregate.
- To search innovative application areas for polymer modified inferior coarse aggregate.

PI: Mr. Wang Junwei

INNOVATIONS

- Ethylene vinyl acetate copolymer was applied to form a polymer mortar modifier, with the water absorption rate and adsorption capacity for admixture of polymer modified inferior coarse aggregate reduced by 80%;
- Developed the pre-mixing process for polymer modified mortar, the initial slump of concrete with polymer modified inferior coarse aggregate increased by 41% compared to unmodified, and the impermeability performance was improved.

PROJECT TEAM

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

1 PATENT

- One mixing and filtering machine for polymer mortar modified coarse aggregate

2 PAPERS

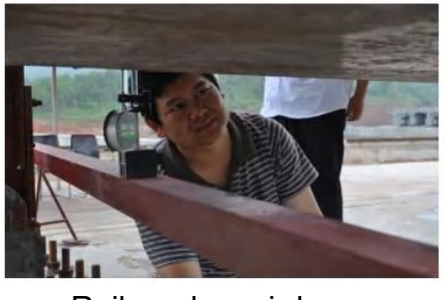
- *Effects of polymer-cement ratio on the properties of polymer mortar*
- *Effect of polymer modified volcanic rock coarse aggregate on properties of concrete*





1 DEMONSTRATION

Polymer modified inferior coarse aggregate applied to concrete sleepers of Beijing-Kowloon railway



Railway box girder



Railway ballastless track

IMPACT

The project achievements effectively reduce the extraction of natural aggregate resources, save land and resource occupation required for solid waste, and have a positive impact on environmental protection. Meanwhile, for areas lacking high-quality coarse aggregate resources, it can greatly alleviate the supply contradiction of coarse aggregate.

Special Mortars & Concrete

ONGOING /80%

2023 TDA 1-1
(JAN 2023 - DEC 2024)

Project Name: Develop hydrocarbon-based graphene for improving properties of concrete

BACKGROUND

Recently, nanomaterials have provided new research ideas in improving the mechanical properties and durability of concrete, and some achievements have been made in concrete field. Graphene has been used as an important nano-filler to improve the service performance of cement concrete materials. How to significantly reduce the cost of graphene preparation, how to achieve multi-functional regulation of the intrinsic properties of graphene and how to meet the multi-functional application requirements of graphene-based concrete materials, which are the urgent issues to be addressed.

AIMS AND GOALS

- To develop the key technologies for low-cost and mass production of hydrocarbon-based graphene with the cost no more than 200 CNY/kg;
- To investigate graphene's influence on concrete properties and their enhanced mechanism;
- To explore low-cost preparation technology of graphene concrete, carbon emission decrease no less than 10 million tons per year.

PROJECT TEAM

中山大學 SUN YAT-SEN UNIVERSITY

武漢理工大學 WUHAN UNIVERSITY OF TECHNOLOGY



PI: Dr. Ying Jie

INNOVATIONS

- A systematic comparative study is conducted on the effects of commercially purchased graphene and graphene produced from petrochemical by-products on the mechanical and durability properties of concrete.
- An innovative new technology for the efficient utilization of graphene is proposed, developing graphene-modified aggregates. This reduces the amount of graphene used while significantly improving the compressive strength, flexural strength, and durability of concrete materials.

1 CONFERENCE PRESENTATION

- “Research and application of graphene in concrete” in International Conference on Building Materials 2024

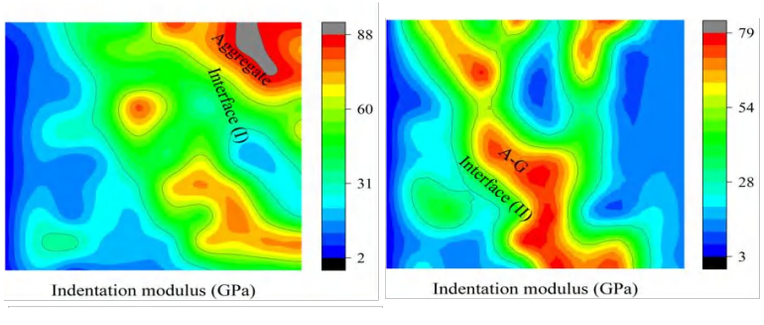


1 PATENT

- Conductive cement-based materials with graphene loaded on aggregates and their preparation methods

1 PAPER

- *A two-step synthesis of porous nitrogen-doped graphene for electrochemical capacitors*



IMPACT

Transforming petrochemical by-products into graphene materials not only opens a new path for the large-scale application of graphene but also greatly enhances resource utilization efficiency and reduces production costs, making the application of graphene in construction more economically feasible. This innovative strategy not only aims to meet the enormous demand for graphene materials in our construction industry but also provides new growth points and opportunities for added value in the petrochemical sector, promoting the collaborative development of the upstream and downstream of the industrial chain.

Special Mortars & Concrete

ONGOING /80%

2023 TDA 6-2
(JAN 2023 - DEC 2024)

Project Name: Research on gradient enhanced polymer modified concrete for structural use and comparison with conventional concrete

BACKGROUND

The addition of polymer into the concrete can greatly improve the toughness and bonding strength of concrete. Hence, the application of polymer modified concrete is one important and efficient way to solve the fast damage of concrete pavement and increase its durability. However, one problem limiting the application of polymer in concrete is the high dosage of polymer, which significantly increases road construction costs. Considering the stress distribution of concrete pavement under load pressure, the top parts are easier to break and more polymers should be concentrated in these key areas. Therefore, it is more and more necessary to realize the local enrichment of polymer in the key areas of concrete pavement and achieve the gradient distribution of polymer inside the pavement structure.

AIMS AND GOALS

- To achieve the gradient distribution of polymer in concrete pavement and improve its mechanical property and durability.
- To build up the technology for the gradient material development and gradient structural design, for the construction of gradient reinforced polymer modified concrete.
- To realize the practical application of polymer modified concrete and promote the usage amount of polymer in the concrete road.

PI: Dr. Lu Zichen



PROJECT TEAM

同济大学 TONGJI UNIVERSITY

TEC

清华大学 Tsinghua University

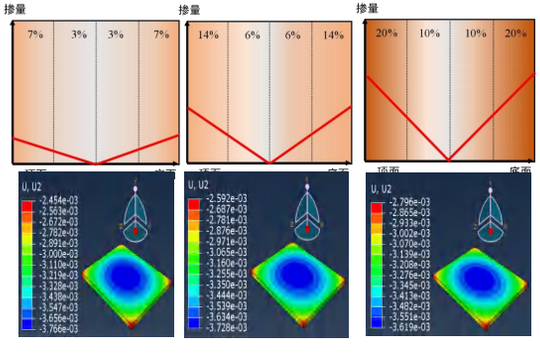
中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

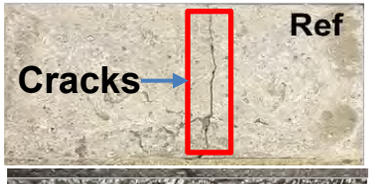
INNOVATIONS

- Magnetic responsive polymer latex was successfully synthesized;
- A finite element model of cement concrete pavement with the gradient structure was established and its reliability was verified;
- The properties of polymer-modified mortar with the gradient structure are thoroughly evaluated;
- The advanced crack and wear resistance of mortar/concrete with the incorporation of magnetic responsive polymer latex was evaluated;
- A device used for the application of magnetic responsive polymer latex was invented.
- The technique for the application of magnetic responsive polymer latex was developed.

IMPACT

The polymer modified concrete developed in the project can effectively solve the problems of weak wear resistance and crack resistance of ordinary cement concrete pavement. Meanwhile, it greatly reduces the dosage of polymer latex and its construction cost. In addition, the application of polymer latex will undoubtedly promote the use and consumption of petroleum based materials.







3 PAPERS

- *Effect of styrene acrylic latex on the performance of metakaolin blended cement: from hydration to mechanical properties*
- *Effect of gradient structure on the performance of polymer-modified mortar*
- *Recent progress of polymer-modified concrete*

1 PATENT

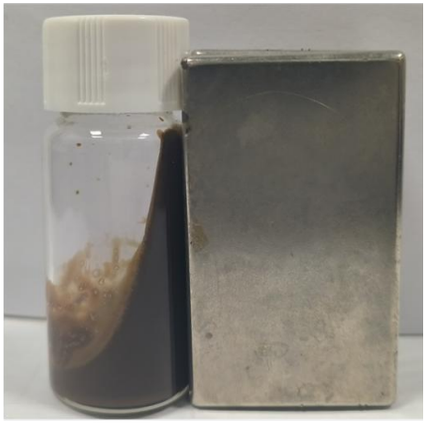
- A device invented for the application of magnetic responsive latex used in concrete pavement

1 STANDARD

- Technical specification for application of polymer modified concrete in pavement

1 DEMONSTRATION

- Concrete pavement used in Shanghai S20 Outer Ring Road





Special Mortars & Concrete

COMPLETED /100%

2023 PHD-6
(JAN 2023 - DEC 2024)

Project Name: Beneficial use of DPCR to prepare CO_2-ready-mix cement based materials

湖南大学 HUNAN UNIVERSITY

BACKGROUND

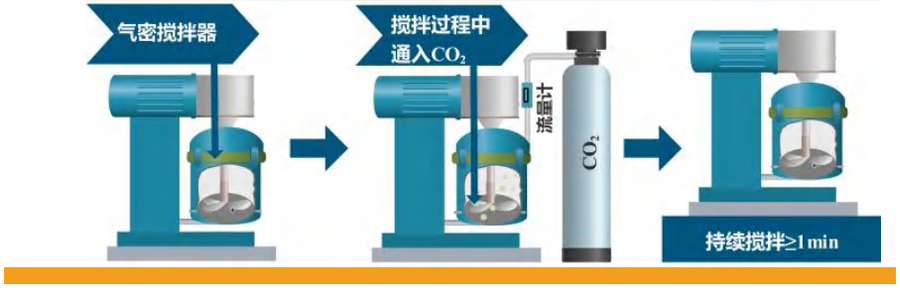
Injecting a precise dose of CO_2 into cement-based materials during the process of mixing (named CO_2-ready-mix cement-based materials) has been proven to be an effective way to rapidly sequester CO_2. However, since CO_2 can only be injected within a few minutes of stirring, resulted in low carbon sequestration and mechanical performance. The preparation of ready-mix cement-based materials using desulfurized petroleum coke residue (DPCR) with high CaO content that can react with CO_2, as an admixture is expected to solve this problem. While, the feasibility and underlying mechanisms of using DPCR for the production of CO_2-ready-mix cement-based materials is still remains unclear and need to conduct research.

AIMS AND GOALS

- To fully utilize the characteristics of desulfurized petroleum coke residue (DPCR) in enhancing the carbon sequestration capacity and mechanical properties of CO_2-ready-mix cement-based materials (CBM);
- To further increase the recycling rate of petroleum coke and lowering the related CO_2 emissions from cement industry;
- To clarify the early and progressive hydration and carbonation mechanisms of the CO_2-ready-mix CBM.



PI: Prof. Ling Tung Chai
Ph.D Student: Dr. Luo Shuang



INNOVATIONS

- Injecting an accurate dose of CO_2 during paste mixing is an effective approach to quickly sequester CO_2 and enhance cement hydration.
- Introducing OPC to the K_2SO_4-intermixed DPCR paste prompts K_2SO_4 to react with $CaSO_4 \cdot 2H_2O$ in OPC paste, reducing the blended cement paste fluidity and accelerating hydration.
- The presence of $CaCO_3$ and $K_2Ca(SO_4)_2 \cdot H_2O$ in the blended OPC-DPCR paste results in a significant 100.7% increase in 1-day strength and a substantial 36.0% increase in 28-day strength.

2 CONFERENCE PRESENTATIONS

- "Enhancing mechanical properties of Portland cement with blending CO_2-intermixed high Belite calcium sulfoaluminate cement" in ICSBM 2023
- "First 60 min behavior of fresh properties and reaction mechanisms of cement pastes intermixed with CO_2" in WASCON-2023





2 PAPERS

- *Modification of early-age microstructure and enhanced mechanical properties of cement paste via injecting low-dose CO_2 at fresh stage.*
- *Effect of CO_2-mixing dose and prolonged mixing time on fresh and hardened properties of cement pastes.*

IMPACT

The use of DPCR as a partial replacement for cement in concrete production enhances resource efficiency and helps address waste storage challenges, promoting sustainable material utilization. Incorporating DPCR into concrete can significantly reduce its carbon footprint, supporting global efforts to lower CO_2 emissions in the construction industry. This approach not only contributes to environmental sustainability but also brings economic benefits by utilizing DPCR as a resource and reducing reliance on traditional cement production.

Special Mortars & Concrete

ONGOING /50%

2024 PHD-8
(JAN 2024 - DEC 2025)

Project Name: Study on the performance regulation mechanism of cement-based materials based on in-situ polymerization

BACKGROUND

Concrete's low toughness and flexural strength, coupled with high brittleness, lead to cracking that accelerates deterioration and reduces load capacity, impacting structural safety. Modern construction demands materials with better crack and toughness resistance. While polymers improve toughness, issues with dispersion and bonding within cementitious materials limit performance gains, and enhancing these properties remains a challenge.

同济大学
TONGJI UNIVERSITY

AIMS AND GOALS

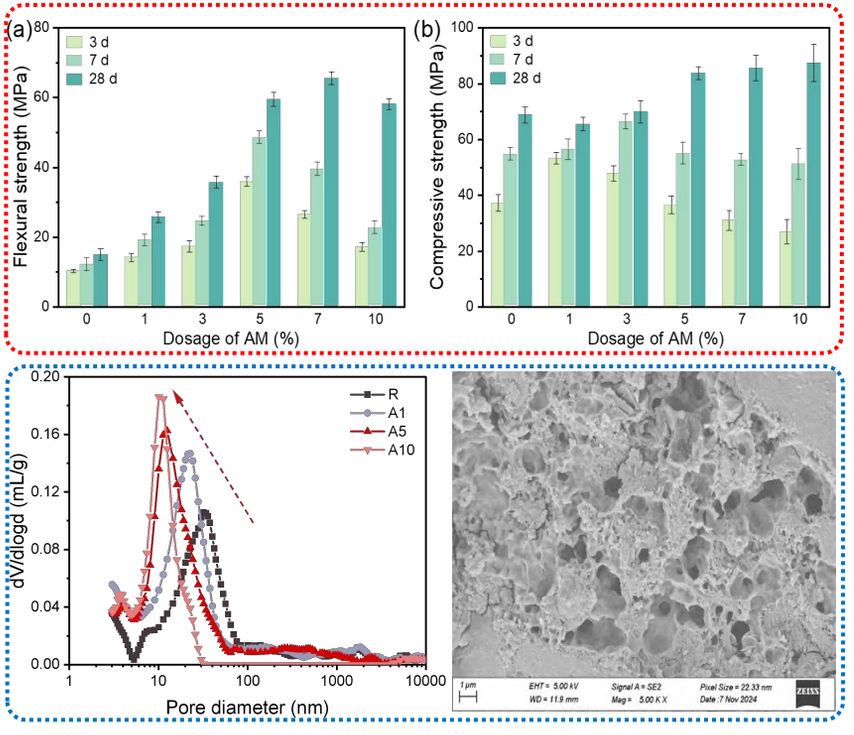
- To develop a cement-based composite material with enhanced flexural strength;
- To foster organic-inorganic bonding between monomers/polymers and cement;
- To clarify the mechanism by which in-situ monomer polymerization modifies the performance and microstructure of cement-based materials.
- To promote the application of oil-based monomers of acrylates in civil engineering materials.



PhD Student: Long Jiangfeng

INNOVATIONS

- Comprehensively analyze effects of monomer polymerization on cement-based materials, select suitable monomers and in-situ polymerization system for Portland cement.
- Deeply analyze interaction between monomer in-situ polymerization and cement hydration kinetics. Optimize system, regulate processes to boost organic-inorganic combination, enhance composite properties and clarify mechanisms.
- Systematically study iPMCC properties and factors. Add inorganic admixtures, to enhance polymer network and its bond, boost mechanical and durability of cement-based materials.
- Conduct multi-scale research to reveal organic-inorganic bonding mechanism. Combine with macroscopic features to explore strengthening and toughening mechanisms of in-situ polymerization.



2 PATENTS

- Organic-inorganic composite modified high strength and high toughness cement-based materials and preparation methods.
- A double network polymer in-situ toughening cement-based material and its preparation method.

1 PAPER

- *Recent advance of monomer in-situ polymerization modified cement-based materials*

IMPACT

The research achievements of this project will have far-reaching impacts in multiple aspects. Doubling the flexural strength can significantly boost the stability and safety of building structure, cut disaster-related damage risks, protect public lives and property, and drive the sustainable development of construction industry.

Special Mortars & Concrete

ONGOING /50%

2024 PHD-9
(JAN 2024 - DEC 2025)

Project Name: Preparation of railway sleepers using engineered cementitious composite (ECC) and research on its static and dynamic mechanical properties

BACKGROUND

Railway sleepers, integral to rail stability and train safety, have traditionally been made of prestressed concrete. Despite its load-bearing strength, this material's susceptibility to cracking under dynamic loads is a concern for high-speed rail safety. Recognizing this challenge, the current study introduces the use of engineered cementitious composite (ECC), a highly ductile material, aiming to diminish the incidence of cracks in railway sleepers and bolster their structural integrity and service performance.

AIMS AND GOALS

- To enhance the crack resistance of concrete and improve its durability.
- To increase the service life of prestressed railway sleepers and enhance the safety and stability of the track structure.
- To be used in railway infrastructure located in complex and difficult terrains where maintenance is challenging, aiming to reduce maintenance requirements and improve robustness.

Université de Lille



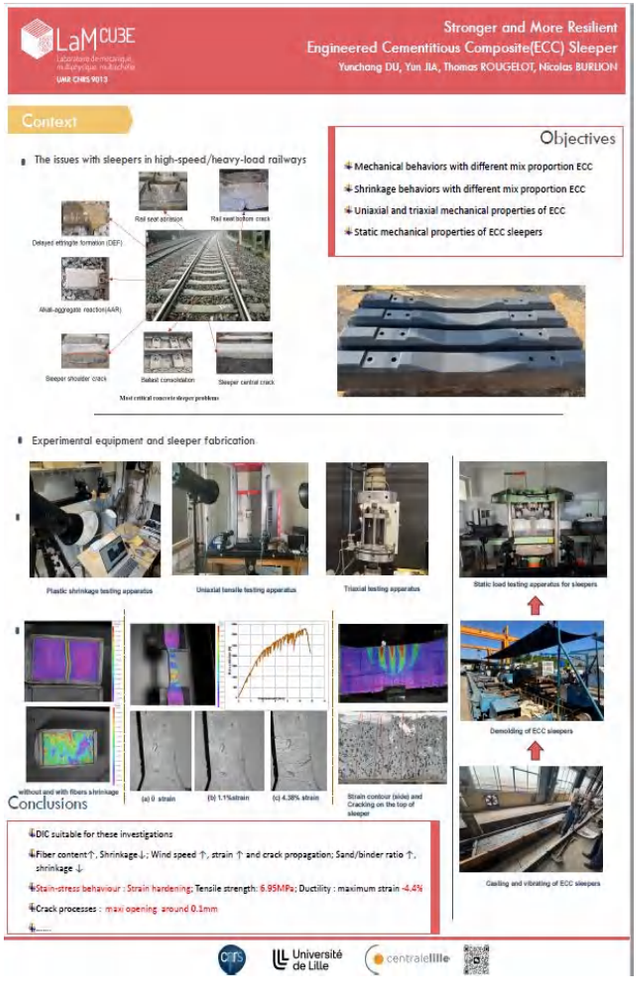
PhD Student: Du Yunchang

INNOVATIONS

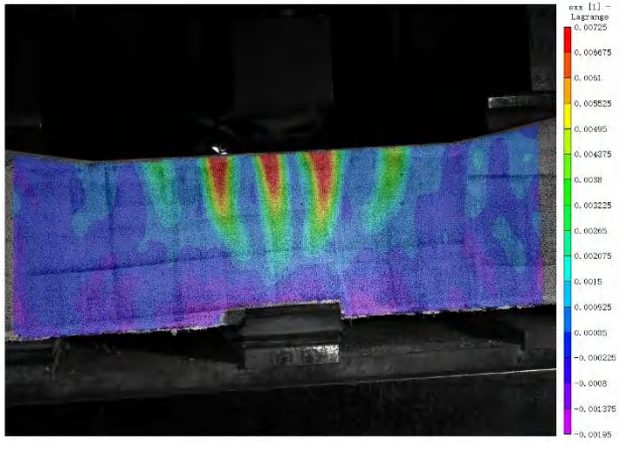
- The world's first prestressed ECC sleeper.
- Self-healing and high ductility properties.
- Adaptation to ultra-high-speed and heavy haul demands.
- Eco-friendly and sustainable development.

IMPACT

- Aligned with the national strategy for a strong transportation network.
- Promote green infrastructure development and drive the railway industry toward sustainability.
- High-durability sleepers reduce railway infrastructure maintenance, lower energy consumption during construction, and minimize construction waste emissions, contributing to the development of a low-carbon and sustainable transportation system.







Special Mortars & Concrete

ONGOING /50%

2024 PHD-10
(JAN 2024 - DEC 2025)

Project Name: Preparation and mechanism of carbon black/cement-based electromagnetic wave absorbing materials with multi-mechanism

BACKGROUND

As a typical petroleum-based material, carbon black (CB) has strong conductivity, high dielectric loss and low price, and has broad application prospects in electromagnetic wave (EMW) shielding building materials. The resonant cavity is an important EMW loss structure in cement-based absorbing materials, but there is a lack of research on the influence and action mechanism of CB on the resonant cavity structure, and the cement matrix lacks macro-structural optimization design, and the absorption mechanism is not clear. The application of CB in cement-based materials is limited, and the absorption performance of cement-based materials urgently needs to be improved.

AIMS AND GOALS

- To reveal the impact of CB on the resonant cavity parameters of the cement matrix, establish the relationship between CB and the resonant structure, and clarify the regulation laws of the resonant structure.
- To explore the relationship between the resonant cavity parameters and EM performance, clarify the influence mechanism of CB on EMW protection performance, and overcome the application difficulties of CB.
- To reveal the relationship between multi-scale resonant structures and absorption performance, as well as the protection frequency band, and their broadband absorption mechanism, and to develop a multi-mechanism absorbing structure construction technology.

武汉理工大学
Wuhan University of Technology



PhD Student: Wu Zihao

INNOVATIONS

- A novel method for the preparation of light weight porous cement-based materials using secondary aluminum ash foaming has been developed, marking the first application of secondary aluminum ash in foamed cement-based materials.
- A scattering-resonance microstructure was constructed based on methods such as aluminum ash foaming and the incorporation of vitreous aggregates. This work revealed the regulation patterns of wave absorption performance in cement-based materials with different scattering-resonance microstructures, facilitating the controllable design of the wave absorption frequency band for light weight cement-based wave-absorbing materials.

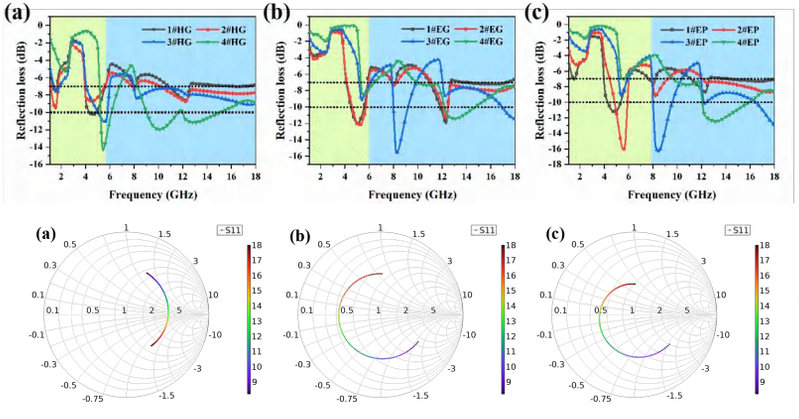
1 CONFERENCE PRESENTATION

The 3rd China Metamaterials Conference



1 PAPER

- *Design of microwave absorbing frequency bands and selection criteria for vitreous aggregates in cement-based materials*

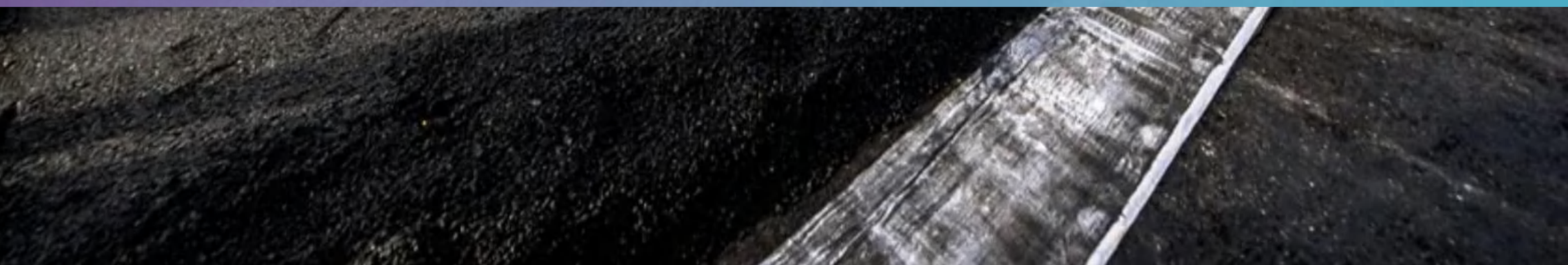


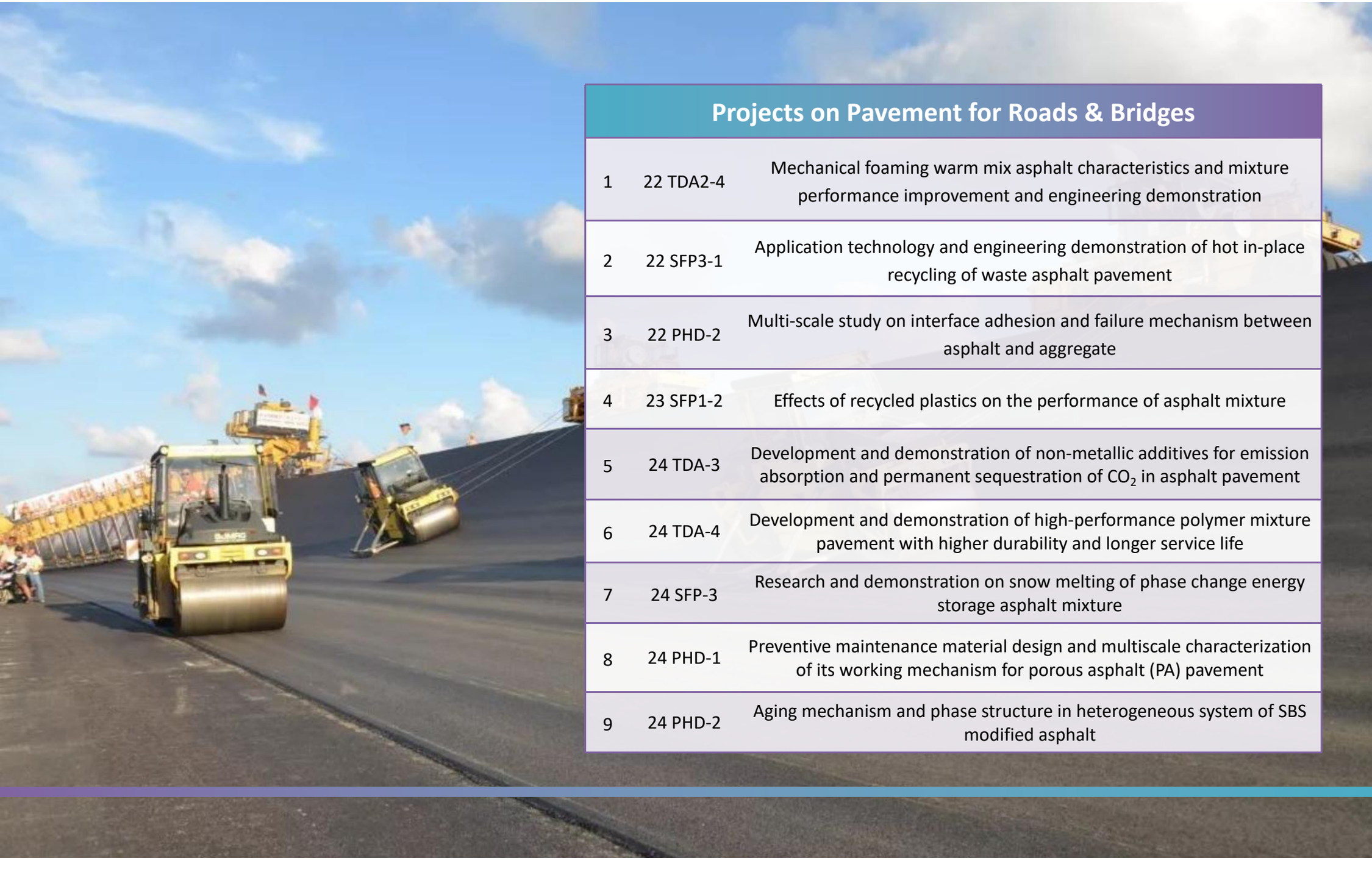
IMPACT

- This work utilizes the gas-generating effect of secondary aluminum ash in an alkali-activated environment, combined with carbon black, to develop light weight cement-based wave-absorbing materials. It enhances the broadband wave absorption performance of cement-based materials, achieving an optimal wave absorption performance of -45 dB in the 1-18 GHz. This approach provides a new perspective for the recycling and utilization of secondary aluminum ash.
- The controllable design of the wave absorption frequency band in cement-based materials has been achieved, providing a theoretical basis for the selection of vitreous aggregates.
- The high value-added application of carbon black from petroleum-based materials in wave-absorbing materials has been achieved.



Pavement
for Roads & Bridges





Projects on Pavement for Roads & Bridges		
1	22 TDA2-4	Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration
2	22 SFP3-1	Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement
3	22 PHD-2	Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate
4	23 SFP1-2	Effects of recycled plastics on the performance of asphalt mixture
5	24 TDA-3	Development and demonstration of non-metallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement
6	24 TDA-4	Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life
7	24 SFP-3	Research and demonstration on snow melting of phase change energy storage asphalt mixture
8	24 PHD-1	Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement
9	24 PHD-2	Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt

Pavement for Roads & Bridges

COMPLETED / 100%

2022 TDA2-4
(JUL 2022 - JUN 2024)

Project Name: Mechanical foaming warm mix asphalt characteristics and mixture performance improvement and engineering demonstration

BACKGROUND

Hot mix asphalt not only consumes large amounts of fuel for heating, but also produces large quantities of greenhouse gases, asphalt fume and other harmful emissions. At present, it is a strategic focus of China and the world to develop the low-carbon economy and low-carbon society. Warm-mix asphalt mixture can greatly reduce the construction temperature by 20-40℃. It conforms to the concept of environmental protection, sustainable development or "green construction".

AIMS AND GOALS

- To study the characteristics of foamed warm-mix asphalt from different oil sources (including Aramco crude oil), and propose the optimal foaming parameters and production process;
- To develop new polymer additive to improve the foaming effect of asphalt, and study the migration-wetting behavior of the additive on the interface of foamed asphalt and aggregate;
- To verify asphalt mixture performance and demonstration.





PI: Dr. Qin Yongchun

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

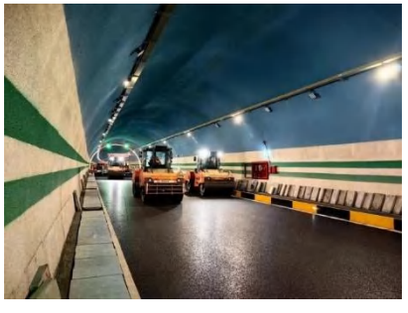
贵州省公路工程集团有限公司
GUIZHOU HIGHWAY ENGINEERING GROUP CO., LTD.

INNOVATIONS

- Using quaternary ammonium salt surfactants, polystyrene butadiene copolymer, and fatty acid alcohol amide as surfactants, the surface energy of asphalt was reduced by 24.3%.
- Additives can improve the water stability of the mixture by 2.7%, and the low-temperature performance can be improved by about 21%.
- Mechanical foaming warm mixed asphalt technology can reduce the construction working temperature by 20-30℃. The compaction effect of the pavement can reach 95%.

IMPACT

Instead of traditional hot mix asphalt for pavement, warm mix asphalt is produced at a temperature 20-40℃ lower than conventional asphalt. The immediate benefit of producing asphalt mixture at a lower temperature is the reduction in energy consumption and gas emissions, such as CO_2, fumes, and volatile gas. Benzene-Soluble Organics was dropped by 80%, and greenhouse gas emissions was reduced by over 50%.The average energy saving is about 25%.





2 PAPERS

- *Effect of warm mix agent on the chemo-mechanical performance of binder with different oil sources (SCI)*
- *Study on rheological properties of warm mixed asphalt (EI)*

1 STANDARD

- Technical specification for mechanically foamed warm mix asphalt

1 PATENT

- An activator for foam local temperature recycling mixture and its preparation method

2 ENGINEERING DEMONSTRATIONS

- Mechanical foaming warm mix asphalt pavement in Xin Jiang G216 expressway
- Mechanical foaming warm mix asphalt pavement in tunnel of Anhui Wuyue Expressway





Pavement for Roads & Bridges

COMPLETED / 100%

2022 SFP 3-1
(JUL 2022 - JUN 2023)

Project Name: Application technology and engineering demonstration of hot in-place recycling of waste asphalt pavement

BACKGROUND

Aged asphalt pavement recycling technology is beneficial to the sustainable development of highway engineering. The hot-in-place regeneration technology can realize the original in-place regeneration of the aged pavement, and can quickly repair the original pavement disease. However, due to the high heating temperature of the original pavement can result to high energy consumption, serious flue gas pollution. Asphalt warm mix technology is a green pavement technology can reduce the construction temperature and achieve the purpose of reducing energy consumption, reducing greenhouse gas and harmful substances emissions.

AIMS AND GOALS

- To research and develop new additives with fast penetration and easy compaction functions for hot-in-place recycling technology of aged asphalt pavement;
- To reduce the construction temperature of hot-in-place recycled asphalt mixture by more than 30°C, compared with the traditional hot-in-place recycling technology;
- To improve the performance of in-place recycled asphalt mixture and meet the specification requirements by optimizing the mineral grading of hot-in-place recycled asphalt mixture and additives.



PI: Prof. Zeng Wei

PROJECT TEAM

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

道路绿色养护 践行者
助力循环经济发展

INNOVATIONS

- The freeze-thaw splitting strength ratio of in-place warm mixed recycled asphalt mixture was increased by 2.4% by using new additives of hydrocarbon-based regenerator (polycyclic aromatic hydrocarbons extracted oil) and warm mixing agent (silane);
- Adopting in-place warm mixed regeneration technology, the construction temperature is reduced by nearly 20℃ and the energy consumption of in-place recycled asphalt mixture construction is effectively reduced.





2 DEMONSTRATIONS

- Hot in-place recycling of waste asphalt pavement in Shanghai-Shaanxi expressway
- Hot in-place recycling of waste asphalt pavement in Baotou-Maoming expressway

1 PAPER

Performance research and engineering application of in-place recycled asphalt mixture with warm mixing technology

1 PAPENT

A kind of hot-in-place recycled asphalt mixture with warm-mixed technology and its preparation method

1 STANDARD

Technical specification for clean hot in-place recycling construction of asphalt pavement

IMPACT

This project increases the benefits from the cost to carbon saving by enhancing the recycling and circularity of materials. The old asphalt pavement was fully recycled in-place, which cut the cost of road pavement, and reduces the emissions of CO_2, NO_x, and smoke by 60%, 70%, and 90% respectively.

Pavement for Roads & Bridges

COMPLETED / 100%

2022 PHD-2
(JUL 2022 - JUN 2024)

Project Name: Multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate

长安大学 CHANG'AN UNIVERSITY

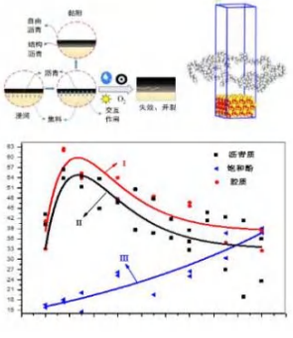
BACKGROUND

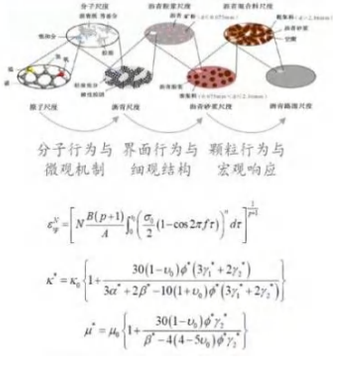
Asphalt mixture was a multi-phase composite material, and the interface was an important factor affecting its bonding strength. Therefore, the interfacial adhesion between asphalt and aggregate has become one of the hot issues in this field in the world, and multi-scale study on interface adhesion and failure mechanism between asphalt and aggregate was a difficult point to be overcome.



PI: Prof. Zhang Jiupeng
PhD Student: Sun Guoqing







AIMS AND GOALS

- To clarify the physical-chemical adsorption configuration of asphalt on aggregate surface;
- To reveal the cross-scale interaction mechanism of asphalt-aggregate interface;
- To reveal the mechanism of interface degradation and failure under the coupling action of environment and load.

INNOVATIONS

- By using the analysis method of asphalt chemical element composition studied the element composition and ratio in asphalt, and established an analysis model for the influence of aggregate mineral composition on the interface performance of asphalt/aggregate;
- The adhesion behavior of asphalt/aggregate interface was studied at the molecular scale, and aggregate type has a greater impact on the interfacial adhesion energy than asphalt type, and the interfacial energy between asphalt and alkaline minerals is significantly better than that of acidic minerals.



3 PAPERS

- *Impacts of asphalt and mineral types on interfacial behaviors: a molecular dynamics study*
- *Interfacial performance of asphalt-aggregate system under different conditions based on molecular dynamics simulation*
- *Comprehensive evaluation of ballastless-track sealants based on macro–micro tests and principal component analysis*

4 CONFERENCE PRESENTATIONS

- “Research on the interface interaction energy of asphalt-aggregate by molecular dynamics simulation” in World Transport Convention 2022
- “Impacts of asphalt and mineral types on interfacial behaviors: a molecular dynamics study” in World Transport Convention 2023
- “Evaluation of the factors on interfacial bond strength and failure mode of asphalt-mineral” in The International Committee on Road and Airfield Pavement Technology 2023
- “Cross-scale analysis of interface properties and evolution behavior of asphalt-aggregate” in the 13th Youth Forum on Road and Airport Engineering Research 2024

IMPACT

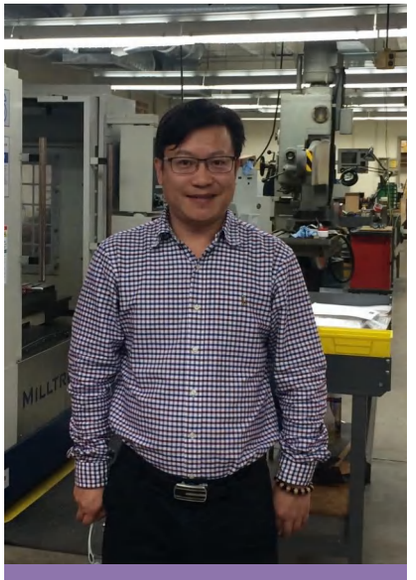
This project focuses on the behavior characteristics of asphalt on aggregate surface, and analyzes the bonding process of asphalt on aggregate surface from macro to micro, from mechanics to physical chemistry, from indirect evaluation to direct characterization with multi-disciplinary theory and multi-scale methods. Through the research of this project, it is expected that new progress and understanding can be made in the physical-chemical adsorption configuration of asphalt on aggregate surface, the migration law of asphalt components, and the multi-scale correlation mechanism of interface adhesion characteristics between asphalt and aggregate. The mechanism of formation, degradation and failure of asphalt-aggregate interface is revealed at molecular level.

Pavement for Roads & Bridges

COMPLETED / 100%

2023 SFP 1-2
(JAN 2023 - JUN 2024)

Project Name: Effects of recycled plastics on the performance of asphalt mixture



PI: Prof. Hou Shuguang

BACKGROUND

The overall recovery rate of waste plastics in China is less than 30%. Using waste plastics in asphalt mixtures is an exploratory way to dispose of waste plastics. More than 15 million tons of recycled thermoplastics will be used in the process of paving or road maintenance every year, which is the inevitable course for the reduction of plastic pollution, petroleum consumption, and promotion for the transformation of petrochemical industry to reduce CO_2 emission.

Integrating the recycled plastic industry with the road paving materials industry is the essential path to reducing plastic pollution, cutting oil consumption, and promoting the carbon transition of the petrochemical industry.

PROJECT TEAM

南京工业大学 NANJING TECH UNIVERSITY

兆维 CHOICEWAY

SQTG 宿迁交通集团 江苏宿迁交通工程建设有限公司 Jiangsu Suqian Traffic Engineering construction Co. LTD

AIMS AND GOALS

- To build up a large-scale step-adding technology for the preparation of high-content recycled thermoplastic-modified asphalt and asphalt mixture;
- To improve the directional gradation design of recycled thermosetting plastics in asphalt mixtures and find out their performance evaluation index;
- To propose the functional oriented stratification design of the paving structure for high-content recycled plastic modified asphalt mixture, as well as the pavement construction technology, and technical guidelines for pavement quality control.

INNOVATIONS

- The process and control parameters for the graded addition of recycled thermoplastics have been determined, achieving a replacement rate of recycled thermoplastic plastics no less than 20% of the asphalt, and a dynamic stability of 9000 times for asphalt mixtures.
- The step crushing and shaping production process of thermosetting plastic fillers was proposed, and the mixing process of recycled thermosetting plastic fillers in asphalt mixture (≥50%) was realized.

IMPACT

In this project, physical and chemical modification methods on waste PE is used to improve the storage stability of polymer modified asphalt using 20% of waste PE. By improving the mixing technology of the asphalt mixture, the mixing uniformity of modified asphalt with high viscosity was achieved and high dynamic stability was obtained.

More than 50% recycled thermosetting plastics was added into asphalt mixtures as fillers. A multi-stage grinding and screening process was built for producing waste thermosetting plastics. The waterproof and high temperature performance of asphalt mixture with 50% of recycled thermoset plastic fillers was better than laboratory tests.

1 DEMONSTRATION

Demonstrations of recycled plastics on the performance of asphalt mixture has been conducted in Suqian, Jiangsu.





2 PATENTS

- Preparation device of waste plastic modified asphalt
- Miscible storage device for waste plastic modified asphalt

1 STANDARD

- Technical specification for application of recycled plastic filler for asphalt mixture

2 PAPERS

- *Microscopic properties of asphalt and polyethylene at an extraordinary high dosage through molecular dynamics simulation*
- *Preparation method and properties of high viscosity and elasticity road asphalt modified with recycled low-density polyethylene plastic at a large dosage*

Pavement for Roads & Bridges

ONGOING / 50%

2024 TDA-3
(JAN 2024 - DEC 2025)

Project Name: Development and demonstration of nonmetallic additives for emission absorption and permanent sequestration of CO_2 in asphalt pavement

BACKGROUND

Volatile organic components (VOCs) and many other hazardous emissions release from asphalt materials during heating process and normal service conditions. Such emissions not only lead to environmental pollution, but also result in degradation of asphalt itself. This project believes that zeolite-based additive might give a chance to reduce the hazardous emissions and provide carbon sequestration, with no negative effect on the road performance of asphalt materials.

AIMS AND GOALS

- Develop green asphalt materials with lower hazardous emissions and remark carbon sequestration behavior;
- Discover the emissions absorption mechanism in asphalt, and carbon sequestration mechanism in pavement;
- Synthesize non-metallic additives for hazardous emission reduction and carbon sequestration in asphalt materials.

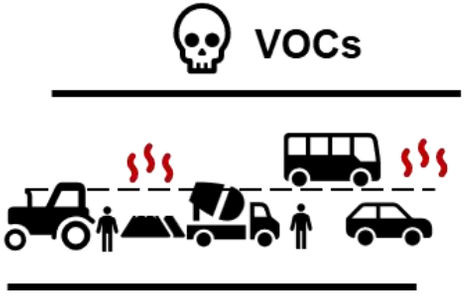


Prof. Dr. Yue Xiao

PROJECT TEAM

长安大学 | 山东大学 SHANDONG UNIVERSITY | 中国能建 ENERGY CHINA | CGGC | 葛洲坝集团交通投资有限公司 GEZHOUBA GROUP TRANSPORTATION INVESTMENT CO., LTD.





INNOVATIONS

- Developed two kinds of emission reduction materials, which can be used in asphalt materials with 43% reduction of VOCs emission.
- Proposed and verified a characterization method for evaluating the carbon absorption and sequestration efficiency of asphalt pavement. And its corresponding device was developed.
- Structural control and surface chemical modification should be further carried out on the emission reduction materials to enhance the higher efficiency of gaseous pollutant reduction from asphalt pavement materials, achieving the research goal of this project.
- Based on the new materials developed in this research project, the field application technology should be forwarded, establishing a complete set of application technologies for reducing gaseous pollutants and carbon absorption and sequestration during the service life of asphalt pavement.

1 PAPER

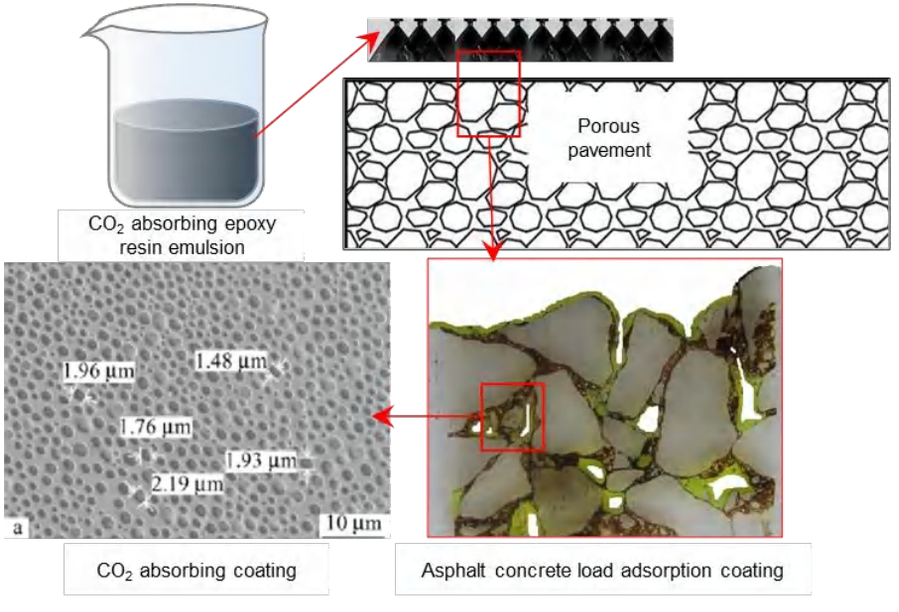
Micro-mesoporous design and modification of molecular sieve for emission reduction of asphalt VOCs.

IMPACT

Simulation and evaluation of adsorption behavior of molecular sieve VOCs on a microscopic scale.

Developed and designed ultra-low emission asphalt material based on microstructure regulation and surface modification of ZSM-5 molecular sieve.

Ecological pavement materials based on the emission reduction of gaseous pollutants – CO_2 absorption and sequestration of pavement composite efficiency mechanism.



Pavement for Roads & Bridges

ONGOING / 50%

2024 TDA-4
(JAN 2024 - DEC 2025)

Project Name: Development and demonstration of high-performance polymer mixture pavement with higher durability and longer service life

BACKGROUND

Polyurethane is a kind of polymer material with excellent performance. The project uses polyurethane adhesive instead of asphalt to improve the road performance and durability. The research results are beneficial to realize the engineering application, standardized construction and industrial production of polyurethane adhesive materials in pavement engineering.

AIMS AND GOALS

- To develop and finalize a polyurethane adhesive for pavement according to the requirements of road performance and construction performance;
- To propose the material composition design method and technical index system of polyurethane mixture;
- To establish the construction technology and quality control method of polyurethane pavement based on road scene.

PI: Prof. Xu Jian



PROJECT TEAM

交通运输部公路科学研究院
RESEARCH INSTITUTE OF HIGHWAY MINISTRY OF TRANSPORT

WANHUA

INNOVATIONS

- By adjusting the compaction temperature and adding additives, the expansion problem of polyurethane mixture during the molding process was effectively controlled, and the expansion height of polyurethane mixture was controlled below 0.7mm.
- Based on the temperature and humidity of the construction environment, a control range for the retention time of polyurethane mixture has been proposed.

1 PAPER

- *Preparation of waterborne polyurethane modified trackless emulsified asphalt and its road performance research*

1 PATENT

- A method for evaluating the degree of curing of polyurethane mixes for road use

1 DEMONSTRATION

- Polyurethane pavement applied in Meishan Inductrial Park, Sichuan

IMPACT

Compared to traditional asphalt mixtures, polyurethane mixtures can achieve room temperature mixing construction, significantly reducing energy consumption during the mixing process of road materials, and reducing CO_2 and harmful gas emissions by more than 80%. In addition, polyurethane mixtures have excellent low-temperature performance, high-temperature performance, and fatigue resistance, effectively extending the service life of pavement.





Pavement for Roads & Bridges

ONGOING / 75%

2024 SFP-3
(JAN 2024 - JUN 2025)

Project Name: Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture

PI: Dr. Li Haijian



BACKGROUND

Ice and snow are the main factors affecting road safety in winter. Conventional ice and snow removal methods consist of the use of deicing chemicals and salts, snowplowing or often both. Such methods can be costly and labor intensive, may have environmental impacts, and can damage concrete pavement. The incorporation of phase change materials (PCM) in concrete pavement is suggested as an alternative method for melting and removing both ice and snow from concrete pavement surfaces or controlling thermal response of concrete pavements during hydration.

AIMS AND GOALS

- To develop a novel petroleum based phase change composite material and apply them to asphalt mixture pavement, with the target of achieving the effect of snow self-melting and deicing on road surfaces;
- Realize the goals of industrial production of petroleum-based phase change composite materials and engineering demonstration of phase change asphalt mixture pavement;
- Clarify the influence of phase change energy storage composite materials on the road performance of phase change asphalt mixtures and the mechanism of their self melting and deicing performance.

PROJECT TEAM

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

河北工業大学
HEBEI UNIVERSITY OF TECHNOLOGY

北京秦天科技集团有限公司
Beijing Qin Tian Science&Technology Group Co., LTD.

INNOVATIONS

- A new type of phase change energy storage composite material with macroscopic solid and microscopic solid-liquid properties has been developed, which solves the problem of leakage in the liquid state of phase change energy storage materials, enhances the stability and durability of the composite material, and greatly improves its ability to melt snow and ice.
- We have overcome the compatibility problem between petroleum-based phase change energy storage composite materials and asphalt mixtures, laying the foundation for the engineering demonstration application of phase change energy storage asphalt mixtures.

IMPACT

- Petroleum-based phase change energy storage snow melting technology can timely and quickly melt snow on roads, with intelligent spontaneous snow melting behavior, reducing the cost of snow melting agents, labor, and the damage of snow melting agents to roads caused by snow removal.
- The application of petroleum based phase change energy storage asphalt concrete pavement reduces the extreme high and low temperature of the pavement, slows down the temperature change rate, and keeps the asphalt pavement at a stable working temperature, reducing pavement temperature diseases, extending the road performance of the mixture, and increasing the service life of the road.

Industrial production line of phase change energy storage composite particles

- Covers an area of more than 500 acres, the self-developed production line
- Intelligent and environment friendly operation progress
- An annual production capacity of up to 60,000 tons.





Pavement for Roads & Bridges

ONGOING / 50%

2024 PHD-1
(JAN 2024 - DEC 2025)

Project Name: Preventive maintenance material design and multiscale characterization of its working mechanism for porous asphalt (PA) pavement

BACKGROUND

Porous asphalt (PA) pavement has been widely used as a functional pavement to improve the skid resistance, water penetration, and noise reduction. However, the raveling problem is a main destress for PA at the early stage due to its high void content and faster ageing. The surface treatment (ST) emulsion, containing asphalt binder and aromatic-based rejuvenators, might be used a preventive maintenance material to effectively alleviate the raveling destress.

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

AIMS AND GOALS

- To evaluate the recovery efficiency of mechanical and functional performances of the damaged PA in laboratory using the ST emulsion;
- To understand the penetration mechanism and diffusion mechanism of ST emulsions in damaged PA mixture;
- To optimize the material design of ST emulsion and develop application guidelines on applying ST emulsion as a preventive maintenance method for PA road surfaces.



PhD Student: Yang Bin

INNOVATIONS

- The penetration depth and coating efficiency of ST emulsion in damaged PA mixture have been proved to significantly affect the ravelling resistance of PA mixture, which inspired the permeability and wettability optimizations of ST emulsion.
- The diffusion coefficient of ST residues was developed to characterize its diffusion phenomenon in aged asphalt mortar of PA mixture.
- The pretreatment method for rejuvenator was proposed, and the optimal dosage of rejuvenator in optimized ST emulsion was determined towards a better ravelling resistance of damaged PA.

2 PAPERS

- *Optimization design of asphalt emulsion with rejuvenator towards a uniform distribution inside the damaged porous asphalt mixture for a better ravelling resistance*
- *Short-and long-term mechanical performances of damaged porous asphalt mixture treated with asphalt emulsion*

1 CONFERENCE PRESENTATION

“Characterization of diffusion of surface treatment emulsion in aged asphalt binder of porous asphalt mixture through SEM/EDS analysis” in the World Transportation Convention 2024



IMPACT

The results of this project are expected to further deepen the understanding of the maintenance mechanism of rejuvenator-optimized emulsions in damaged PA mixtures, ultimately guiding the material design of ST emulsions and extending the service life of old PA pavements. The research results promote sustainable development and resource conservation in the road construction industry and are in line with carbon neutrality goals.

Pavement for Roads & Bridges

ONGOING / 50%

2024 PHD-2
(JAN 2024 - DEC 2025)

Project Name: Aging mechanism and phase structure in heterogeneous system of SBS modified asphalt

哈爾濱工業大學
HARBIN INSTITUTE OF TECHNOLOGY

BACKGROUND

Improving aging resistance properties of SBS-modified asphalt could be an effective solution for both resource saving and environmental conservation. Although aging behavior has been largely discussed in the asphalt industry, SBS-modified asphalt has a complicated aging mechanism due to the presence of SBS copolymer and stabilizer. Thus, the project aims at improving the anti-aging properties and durability of SBS modified asphalt using organic materials such as waste rubber particles and carbon black, addressing the aging resistance fundamentally through a phase structure perspective.

AIMS AND GOALS

- To propose a phase structure definition based on mechanical states, and establish aging characterization indicators for SBS-modified asphalt based on the phase structure;
- To establish a method for correlating mechanical states with rheological parameters;
- To analyze the composite aging mechanisms in the multiphase system of SBS-modified asphalt, including modifiers, stabilizers, and base asphalt.



PhD Student: Zhang Junjie

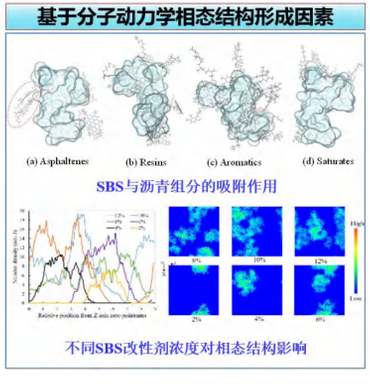
INNOVATIONS

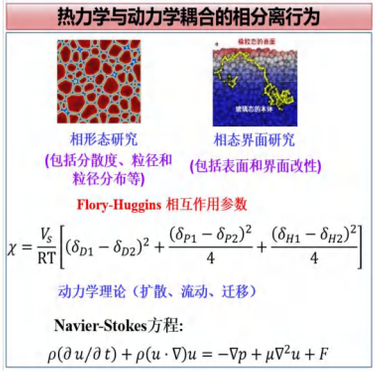
- A method was proposed to quantitatively evaluate the ductile-brittle transition in SBS-modified asphalt, tracing its aging-related evolution from multi-phase ductile to single-phase ductile and then brittle behavior. Ten different SBS-modified asphalt systems were quantitatively assessed for anti-aging performance using a combined mechanical property and aging model approach;
- The key mechanical behavior transitions of three asphalts during aging was revealed. By evaluating various quantitative correlation methods between rheological characteristics and mechanical behavior, and exploring the applicability of various master curve models in aging analysis and the sensitivity of their parameters to aging response, this research provides a unified characterization of the transitions of different mechanical states such as viscoelastic, viscoelastic and glassy states of the material during aging.

1 CONFERENCE PRESENTATION

- “Quantitative characterize binder blending and diffusion in recycled asphalt mixture: an environmental-friendly solution using wooden cube and 3D fluorescence image technology” in World Transport Convention 2024







1 PAPER

- *Investigating the role of sulfur stabilizer in modulating aging properties of SBS-modified asphalt*

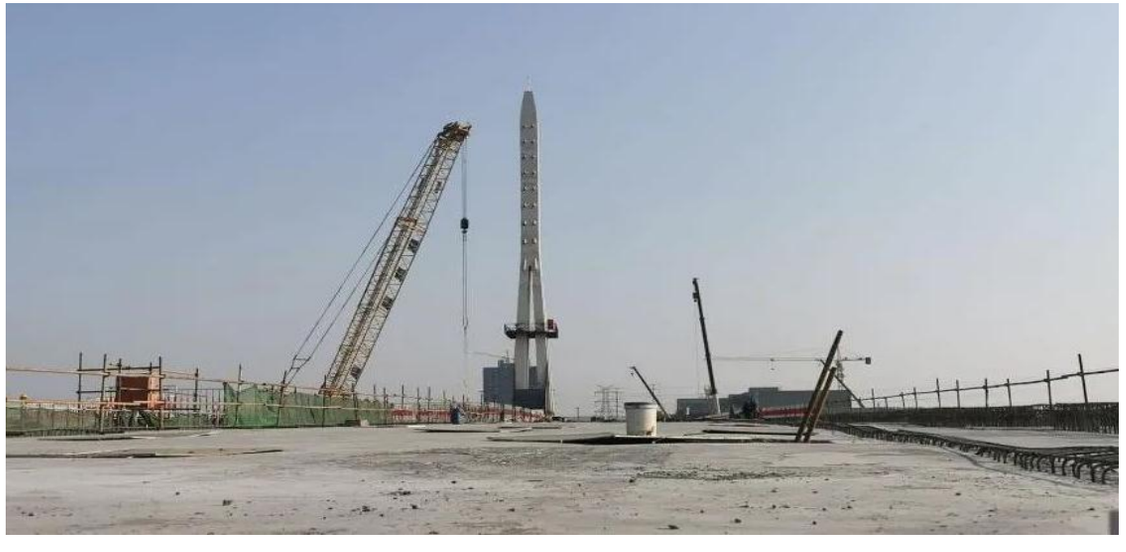
IMPACT

The impact of this research lies in providing a comprehensive understanding of the aging process of SBS-modified asphalt, advancing the development of more durable and sustainable road materials. By establishing a cross-scale correlation between macroscopic properties and microscopic mechanisms, this research contributes to the optimization of anti-aging performance and offers practical guidance for improving the design and longevity of asphalt materials, thus benefiting both the environment and society.



Construction Chemicals

Projects on Construction Chemicals		
1	22 TDA3-1	Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer
2	22 SFP2-1	Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil
3	22 PHD-3	Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials
4	23 SFP3-2	Standardization and demonstration of preparing building formwork with waste plastics
5	23 SFP4-1	Development of self-healing fire-retardant coatings highly compatible with non-metallic surfaces







Construction Chemicals

COMPLETED / 100%

2022 TDA3-1
(JUL 2022 - JUN 2024)

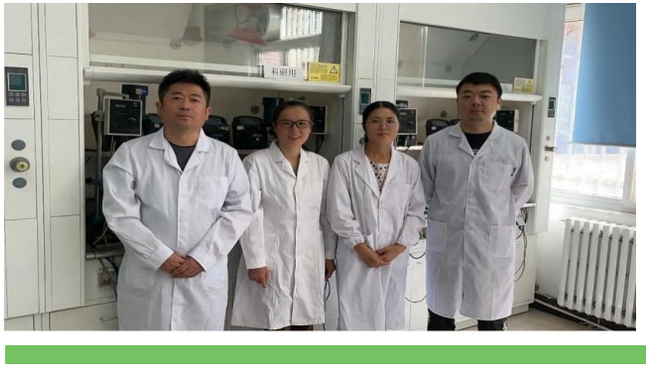
Project Name: Research and application of novel polyether macromonomer and ultra-highly dispersing polycarboxylate superplasticizer

BACKGROUND

Ultra-high performance concrete (UHPC), has achieved a great leap in the performance of engineering materials, with ultra-high strength, low brittleness and excellent durability, which can effectively compensate for many shortcomings of ordinary concrete. However, UHPC is usually reinforced and toughened by adding steel fiber or polymer fiber, resulting in poor fluidity, high viscosity, high cost of the mixture, which greatly limits its application in multiple scenarios. Develop a new type of polycarboxylate superplasticizer with ultra-high water reduction rate to reduce the water-binder ratio and obtain the good workability and ultra-high strength of UHPC.

AIMS AND GOALS

- To synthesize new type polyoxyethylene ether monomer and ultra-highly dispersing water reducer;
- To prepare UHPC concrete material with ultra-highly dispersing water reducer, and elaborate the mechanism of achieving high dispersion in ultra-low w/c ratio systems;
- To realize the reduction of cement dosage, w/c ratio, durability, CO_2 and cost in C30~C50 concrete through the different dosages of polycarboxylic acid superplasticizers.



PROJECT TEAM

中国建筑材料科学研究总院有限公司
China Building Materials Academy Co.,Ltd.

中国建筑材料科学研究总院
中建材中岩科技有限公司
CNBM Zhongyan Technology Co., Ltd.



PI: Mr. Bai Jie

INNOVATIONS

- A novel polyether monomer was prepared by ethoxylation of unsaturated ether alcohol and ethylene oxide, and ultra-high dispersion water reducer was synthesized by free radical polymerization. When applied to C30 concrete, the water reduction rate of concrete is greater than 45%, and the amount of cementitious materials is reduced by 20%.
- UHPC containing ultra-high dispersion water reducing agent, the 1d compressive strength under non-steam curing was more than 60 MPa, 28d compressive strength was more than 150 MPa, and 28d flexural strength was more than 26 MPa.

4 PAPERS

- *Preparation and performance of EPEG-type PCE and its application in ultra-high performance concrete*
- *Research status and prospect of domestic polyether macromonomer*
- *Research on the mix proportion of low-carbon concrete utilizing a novel polycarboxylate superplasticizer*
- *Research on the effect and mechanism of binder-sand ratio on UHPC performance*

1 STANDARD

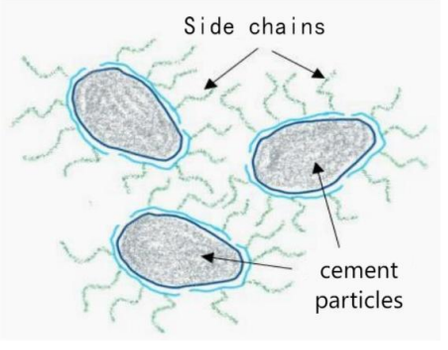
- Polyeyher and its derivatives for concrete admixtres

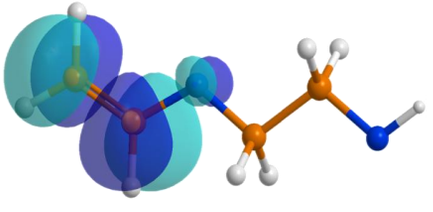
4 PATENTS

- An ultra-high dispersed water reducer and its preparation method
- An ultra-high dispersed water reducer and its preparation method
- A hyperbranched polyether and its preparation method
- An ultra-highly dispersing polycarboxylate superplasticizer and its preparation method

3 DEMONSTRATIONS

- Pilot production of novel polyether macromonomer
- Ultra-highly dispersing PCE for UHPC applied to Moshuihe Bridge and Xiaoqinghe Bridge in Shandong
- Ultra-highly dispersing PCE for low carbon concrete design applied to Dezhou City in Shandong







IMPACT

UHPC with high strength grade prepared by ultra-highly dispersing polycarboxylate superplasticizer can be used in bridge engineering such as precast bridge deck, precast box girder, bridge deck pavement, expansion joint pouring, etc. Project results can guide the reduction of cement content by more than 20% and water consumption by more than 45% by increasing the dosage of polycarboxylate superplasticizer.

COMPLETED / 100%

2022 SFP 2-1
(JUL 2022 - JUN 2023)

Project Name: Research and demonstration application of admixtures for (ready-mixed fluid) solidified soil

PI: Mr. Wang Jian



BACKGROUND

Soil solidifying agent, which adsorbs on the surface of soil particles through ion exchange and prevents water from adsorbing again into a film to solidify the soil, is widely used in road construction. The use of solidified soil construction technology with a certain flow state or half flow state, which convenient for the construction process and reduce carbon emissions.

AIMS AND GOALS

- To form a series of solidification soil with adjustable performance according to different soil properties, different construction requirements and application scenarios;
- To prepare a special hydrocarbon-based dispersants and anti-separation agents, which are used to improve the fluidity of fluid soil, the mechanical properties and anti-dispersion properties of solidified soil;
- To realize the slump of solidified soil no less than 240 mm, the 28d compressive strength is controlled at 1.0-10.0 MPa, and the water stability coefficient is no less than 110%.



PROJECT TEAM

中国建材 中国建筑材料科学研究总院 中建材中岩科技有限公司 CNBM Zhongyan Technology Co., Ltd.

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY

北京財貿職業學院 BEIJING COLLEGE OF FINANCE AND COMMERCE

INNOVATIONS

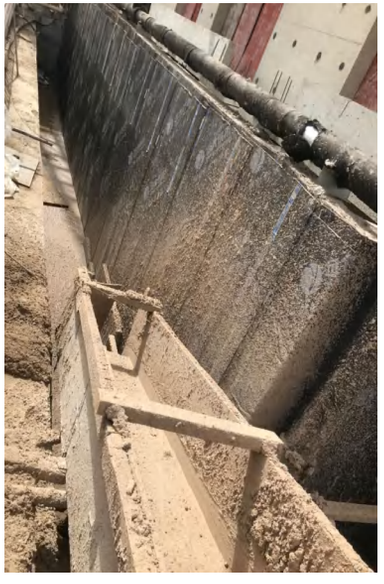
- A dispersant for ready-mixed fluid solidified soil was prepared by copolymerization of sodium methacrylate sulfonate, methyl acrylate, acrylic acid, and polyether macromers, which improved the flowability of the fluid solidified soil by over 250 mm and the slump of 1.5 h was greater than 200 mm;
- Developed resin composite technology of epoxy resin E51, fatty amine 593 and phenolic amine 8813 with backfill soil, prepared two types of polymer solidified soil by using compaction techniques with the 6 h compressive strength is 5 MPa and 7d unconfined compressive strength exceeded 30 MPa.

2 PAPERS

- *Research on properties of sulfoaluminate cement-based premixed fluid solidified soil curing agent*
- *Fluid solidification of construction waste soil*

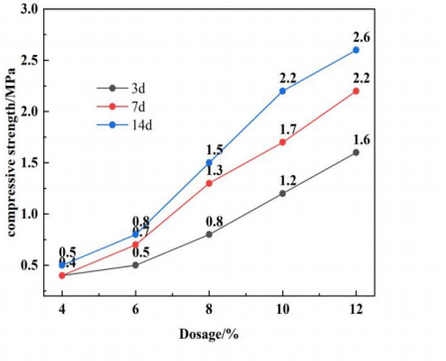
1 DEMONSTRATION

- Admixtures for solidified soil applied to fabricated building in Beijing



2 PATENTS

- A special dispersant for soil stabilizing admixture and its preparation method and application
- Anti-washout stabilizing admixtures for Solidification of underwater sludge and its preparation method and application





IMPACT

By replacing traditional inorganic solidified agents with polymer admixtures for solidified soil, which can reduce carbon emissions and atmospheric pollution, protect mining resources, and realize sustainable development. With the vigorous development of infrastructure construction in China, polymer admixtures for solidified soil have broad application prospects. Compared with traditional technologies, using polymer admixtures for solidified soil construction can save an average of 30-60% of costs.

Construction Chemicals

COMPLETED / 80%

2022 PHD-3
(JUL 2022 - JUN 2024)

Project Name: Preparation and properties of petroleum coke porous carbon/paraffin composite phase change materials

BACKGROUND

As a kind of thermal storage technology, a large amount of energy conversion in a small temperature range can be realized by phase change technology. Energy storage can be realized by phase change materials, which utilizes the characteristics of heat absorption during melting and heat release during solidification to achieve effective storage and utilization of heat energy. Phase change materials can be applied to construction, which has a very strong market demand and application prospects.



PI: Prof. Lv Guocheng

中国地质大学
CHINA UNIVERSITY OF GEOSCIENCES
北京 · BEIJING



PhD: Bian Jianhua

AIMS AND GOALS

- To prepare new petroleum coke porous carbon/paraffin composite phase change materials;
- To study thermal conductivity enhancement mechanism of petroleum coke porous carbon/paraffin composite phase change materials;
- To study thermal cycling enhancement mechanism of petroleum coke porous carbon/paraffin composite phase change materials.

INNOVATIONS

- First report on the preparation of petroleum coke porous carbon (PCPC) using salt template method, with petroleum coke as raw material and its application in paraffin wax encapsulation.
- The composite phase-change materials prepared by encapsulating paraffin wax with PCPC as the encapsulation material has good encapsulation performance, high thermal conductivity, and long thermal cycling stability.
- PCPC-PW demonstrate excellent photothermal conversion capability.
- PCPC-PW have electrothermal conversion capability.

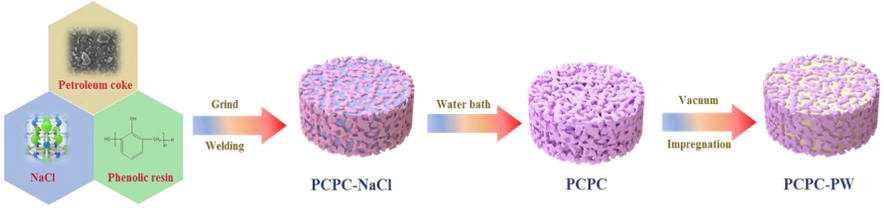
1 CONFERENCE PRESENTATION

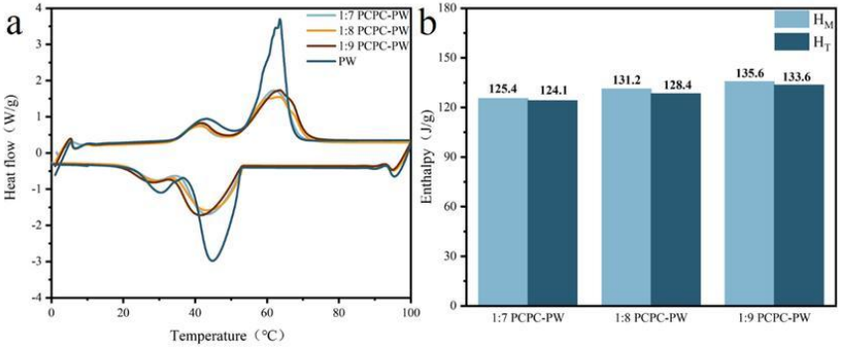
China Materials Conference 2022-2023



2 PAPERS

- *Preparation strategy of photo-thermal composite phase change materials: a review*
- *Research progress of biomass materials in the application of organic phase change energy storage materials*





IMPACT

Hydrophobic petroleum coke porous carbon with a three-dimensional network structure was prepared using the salt template method and used for encapsulating paraffin wax. Composite phase change materials exhibit excellent heat absorption/release capabilities, while petroleum coke also endows them with the ability for photothermal and electrothermal conversion. This work provides a new method for the comprehensive utilization of petroleum coke in the field of phase change thermal management and energy.

Construction Chemicals

COMPLETED / 100%

2023 SFP 3-2
(JAN 2023 - JUN 2024)

Project Name: Standardization and demonstration of preparing building formwork with waste plastics

BACKGROUND

Waste plastic causes ecological damage. Recycling is an effective way to solve the problem of waste plastics. As a new type of green and environmental protection building formwork, plastic formwork has been applied in building and bridge engineering. It can recycle waste plastics and has a broad application prospect. However, the lack of relevant standards for preparing building formwork with waste plastics limits its promotion and application.

PROJECT TEAM

ctc 国检集团

北京交通大学 BEIJING JIAOTONG UNIVERSITY

皓强科技

AIMS AND GOALS

- To formulate the product standards, thus to promote the application of plastic formwork.
- To improve resource utilization of waste plastics in the preparation of building formwork, and to reduce cost and avoid pollution to ecological environment.





PI: Mr. Liu Shunli

INNOVATIONS

- Five major general plastics and five engineering plastics were investigated from performance, application and post-waste application; Polypropylene, PVC and polycarbonate plastics suitable for the production of building formwork were selected; The use of waste plastics to prepare plastic formwork can reduce carbon emissions, such as PVC building formwork prepared with 80% waste plastics can reduce carbon emissions by 58.37% compared with raw materials.
- The proportion of waste plastic in the production of plastic formwork is more than 50%; and after third-party testing, the performance of the plastic formwork meets the technical requirements of JG/T 418-2013 “plastic formwork”, and is applied to the construction of Ziyuntai residential project in Xuchang, Henan, and the application amount reaches 6200 m^2;
- The standard of recycled plastics used in building formwork is made to ensure the quality of plastic formwork and guide the application of more types of waste plastics in construction plastic formwork.

1 STANDARD

- Group standard - 'Recycled plastics for building plastic formwork', China Building Materials Federation

1 DEMONSTRATION

- Waste plastic applied to building formwork in Xuchang, Henan

1 PRODUCTION LINE

- Building formwork with waste plastic




CBMF
中国建筑材料协会标准
T/CBMF ××-20××
建筑塑料模板用再生塑料
Recycled plastics for building plastic formwork
（报批稿）
20××-××-××发布　20××-××-××实施
中国建筑材料联合会 发布





IMPACT

- The standard of recycled plastics used in building formwork is made to fill the gap of the lack of raw material standards in the industrial chain of plastic formwork.
- Improve the quality of plastic formwork products from the source and promote the healthy development of the plastic formwork industry.
- Guide the application of more waste plastic categories in building formwork and further promote the use of waste plastics, China‘s annual plastic building formwork market is 19 million m^2, if the use of waste plastics can reach more than 50%, more than 90,000 tons of waste plastics will be used, which is of great significance to protect the ecological environment.

COMPLETED / 100%

2023 SFP 4-1
(JAN 2023 - JUN 2024)

Project Name: Development of self-healing fire-retardant coatings highly compatible with nonmetallic surfaces

BACKGROUND

In order to make fiber-reinforced polymers (FRP) from combustible to non-combustible and to reduce the fire-catching and spreading threats to the buildings, the fire-retardant coating plays an important role in fire protection and decoration. Intumescent coatings are widely used due to their low cost and excellent fire resistance characteristics. However, when this kind of coating is subjected to external forces, it is prone to produce microcracks, resulting in poor fire resistance. The addition of self-healing fillers and flame retardants to the fire-retardant coatings is the most common and effective measure to deal with this problem, which can reduce the hazards and losses by fire.



PI: Prof. Zhao Jingmao

北京化工大学
BEIJING UNIVERSITY OF CHEMICAL TECHNOLOGY

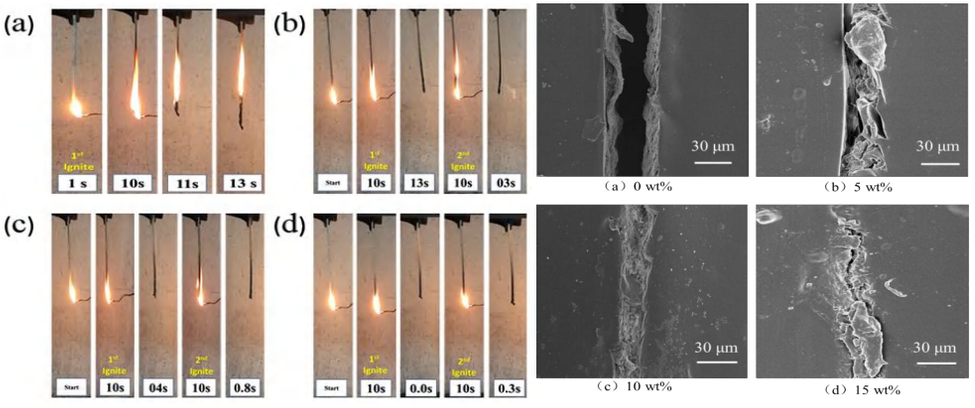


AIMS AND GOALS

- To develop a self-healing fire-retardant coating applied to the FRP surface with the addition of hydrocarbon-based flame retardants and self-healing fillers;
- To study the optimum usage of fire-retardant and self-healing additive in the coatings and their interaction;
- To carry out the research on construction technology and coating performance evaluation of fire-retardant coatings.

INNOVATIONS

- Tween-20 was used as an emulsifier to successfully synthesize microcapsules with tung oil as the core material and urea-formaldehyde resin as the wall material, and the epoxy coating with addition of 10 wt.% microcapsules exhibits excellent self-healing properties.
- 8-hydroxyquinoline (8HQ) intercalated CaAl-based layer double hydroxide (CaAl-8HQ-LDH) was loaded on rGO through one-pot hydrothermal reaction, which was employed as the nanofiller endowing epoxy coating with excellent flame-retardancy.
- The composite material with the addition of 10 wt% microcapsules and 15 wt% flame-retardant can pass the UL-94 vertical combustion test with V0 level, water resistance over 200h, and self-healing rate of 108.8%.



1 PATENT

- Preparation of a Ca-Al based layer double hydroxide nano-filler and application in corrosion and fire resistance

3 PAPERS

- *Preparation of tung oil microcapsules and their self-repairing properties*
- *Protective and flame-retardant bifunctional epoxy-based nanocomposite coating by intercomponent synergy between modified CaAl-LDH and rGO*
- *Preparation of graphene oxide encapsulated aluminum hypophosphite and its improvement on mechanical property and flame retardancy in polycarbonate/acrylonitrile-butadiene-styrene*

1 STANDARD

T/CSCP 0003-2023 'Self-healing performance evaluation methods of organic coatings

IMPACT

To make the fiber reinforcement material from combustible to non-combustible, the fire-retardant coatings are applied on the surface of the substrate. The addition of self-healing nano-fillers and flame retardants to the coatings will be the most effective strategy to deal with this problem. The flame-retardant performance of the combined coating has reached V-0 level, the strength self-healing rate within 24h is higher than 80%, and the adhesion of coating to the surface of FRP is increased by more than 20%. This technology can significantly improve the fire-retardant performance of materials, reduce the hazards and losses by fire.



Waterproofing & Repair Materials

Projects on Waterproofing & Repair Materials		
1	23 TDA2-2	Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life
2	24 PHD-7	Preparation and performance of self-healing polymer modified asphalt waterproofing membrane





Waterproofing & Repair Materials

ONGOING / 95%

2023 TDA2-2
(JAN 2023 - DEC 2024)

Project Name: Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life

BACKGROUND

Traditional waterproofing membranes are mainly based on asphalt based products with relatively low UV resistance, which are not suitable for outdoor projects. Thermoplastic polyolefin (TPO) waterproofing membranes have a clear structure, better mechanical properties and durability, stable quality, relatively low maintenance costs, and strong lap reliability, making them suitable for outdoor roof waterproofing projects. However, this material has the problem of flammability and insufficient long-term high-temperature durability. Therefore, this project carries out related work to develop a new type of TPO waterproof membrane.

AIMS AND GOALS

- Developing a TPO flame retardant masterbatch.
- Developing a new type of composite weather resistant additive system, which is suitable for long-term high-temperature conditions.
- Developing high flame retardant TPO coil formula and high weather resistant TPO coil formula.



PI: Ph.D HU Quanchao

INNOVATIONS

- To solve the problem of dispersion and flame retardant efficiency of traditional flame retardants, POE-g-MAH polymer compatibilizer and $Mg(OH)_2$-PAPP synergistic composite flame retardant have been developed. A twin-screw extrusion granulation process for TPO masterbatch has been created, achieving efficient flame retardant modification of TPO waterproof membrane with a flame retardant grade of B2(E).
- To ensure the durability of TPO waterproofing membrane under long-term high-temperature outdoor conditions, this project focuses on the mechanisms of TPO thermal and photo oxidative aging, and conducts research on multiple aspects such as different antioxidants and various light stabilizers with their synergistic mechanisms. Based on cost-effectiveness, the product's resistance to thermal and photo oxidative aging has been improved, and it has been tested through 135 ℃ -60 days and 115℃-224 days thermal aging.

1 DEMONSTRATION

- Western Science City project in Chongqing



2 PATENTS

- A TPO composite waterproofing membrane (2024109234376)
- A waterproofing membrane (202410923013X)

2 PAPERS

- *Performance of thermal-oxidative aging on the structure and properties of ethylene propylene diene monomer (EPDM) vulcanizates*
- *Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*

1 STANDARD

- T/CECS 10374-2024 Pre-applied butyl rubber waterproof membrane

IMPACT

The product developed in this project has unparalleled advantages in durability and flame retardancy compared to similar products in the market. Compared with similar products, the lifespan of the product developed in this project can be extended to more than 25 years, reducing construction costs by 10% and energy consumption by more than 10% during the construction process.

Waterproofing & Repair Materials

ONGOING / 50%

2024 PHD-7
(JAN 2024 - DEC 2025)

Project Name: Preparation and performance of self-healing polymer modified asphalt waterproofing membrane

BACKGROUND

Waterproofing membrane is an important protective material for preventing building leakage. However, polymer modified asphalt waterproofing membrane is prone to aging under the influence of environmental factors, which not only causes leakage but also greatly reduces the durability of waterproofing membrane. Therefore, it is of great significance to develop anti-aging polymer modified asphalt waterproofing membrane with self-healing function.

AIMS AND GOALS

- To improve the self-healing performance of polymer modified asphalt waterproofing membrane by breakage-rearrangement effect of dynamic disulfide bonds.
- To develop an anti-aging polymer modified asphalt waterproofing membrane with self-healing function.
- To investigate the improvement mechanism of dynamic disulfide bonds on self-healing and anti-aging performance for waterproofing membrane.

武漢理工大學
WUHAN UNIVERSITY OF TECHNOLOGY



PhD Student: Zhang Tianwei

INNOVATIONS

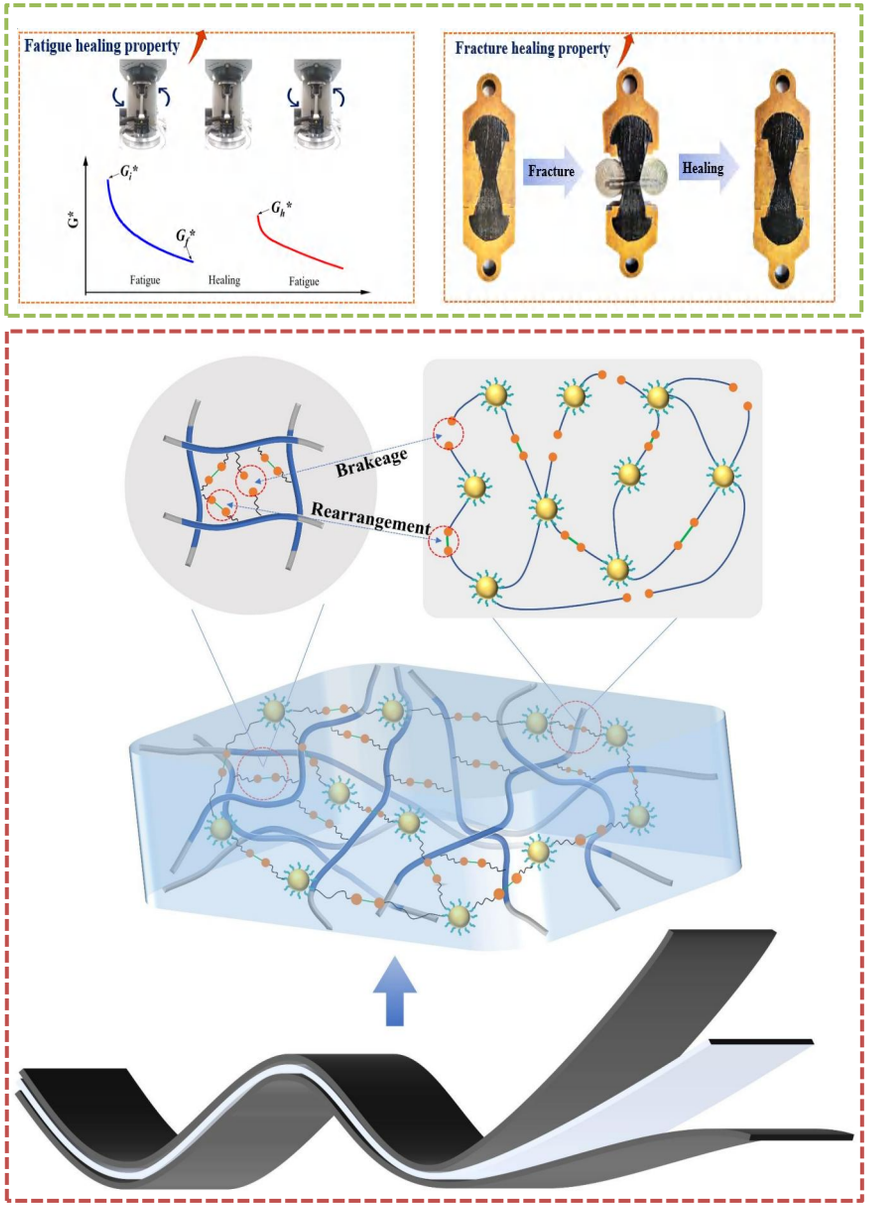
- It was first proposed to introduce dynamic disulfide bonds with self-healing ability into the SBS network structure, and to significantly improve the self-healing performance of SBS modified asphalt.
- It was first proposed to introduce dynamic disulfide bonds between crumb rubber to improve the self-healing performance of crumb rubber modified asphalt.
- The self-healing performance of the waterproofing membrane are significantly improved through the dynamic disulfide bonds of SBS network structure and crumb rubber particles.

IMPACT

This project has developed an aging resistant polymer modified asphalt waterproofing membrane with self-healing function. The project results have laid a theoretical foundation for the development and application of self-healing polymer modified asphalt waterproofing membranes with superior aging resistance.

3 PAPERS

- *Development of sustainable desulfurized waste crumb rubber modified asphalt with enhanced self-healing properties.*
- *Multiscale study on fatigue healing performance and molecular healing behavior of self-healing SBS modified bitumen.*
- *Effect of aging on structure and properties of self-healing-enhanced SBS modified asphalt with dual dynamic chemical bonds.*





Insulation & Composite Cladding

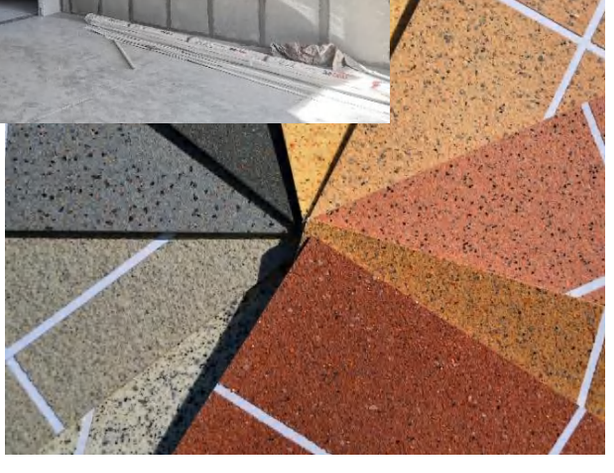
Projects on Insulation & Composite Cladding		
1	22 SFP4-1	Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel
2	23 TDA3-2	Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings
3	24 TDA-2	Development and demonstration of polymer aerogel composites
4	24 TDA-5	Develop certification for external thermal insulation composite systems (ETICS)
5	24 PHD-3	Surface modification of extruded polystyrene foam and the study of its flame retardancy and adhesion performances











Insulation & Composite Cladding

COMPLETED / 100%

2022 SFP 4-1
(JUL 2022 - JUN 2023)

Project Name: Investigation on recycled polystyrene particles/foamed concrete composite insulation material and its application in composite sandwich panel

BACKGROUND

Expanded Polystyrene (EPS) foam products made of styrene extracted from petroleum resources are used in various fields of society, and most of them are discarded after use, resulting in great resource waste and great damage to the ecological environment. How to effectively use abandoned EPS foam, turn waste into treasure, and reduce the secondary pollution of EPS foam is of great significance to the sustainable development of society. Waste EPS foam is used as light aggregate for recycling and utilization. Based on the problems existing in the preparation of light weight concrete with recycled EPS as aggregate and the current development trend of building assembly, recycled EPS particles, foamed concrete and calcium silicate board are used to prepare composite sandwich wall panels.



PI: Dr. Li Fangxian

華南理工大學
South China University of Technology

AIMS AND GOALS

- By pre-wrapping method to avoid the floating of recycled EPS particles, to achieve the uniformity and stability of recycled EPS particles/foam concrete insulation material slurry;
- To study the bubble stability in recycled EPS particles/foamed concrete slurry, and explore the solution of slurry collapse to promote the application of recycled EPS particles/foamed concrete insulation in composite sandwich wall panels;
- To propose the method of solving core material cracking and stripping core material from panel, and improve the quality of composite sandwich panel;
- To optimize the performance and construction method of recycled EPS particle/foamed concrete composite sandwich panels.

INNOVATIONS

- A double-coating particle pre-treatment method with coated slurry and composite coating was used to achieve the uniform distribution of EPS particles in cement-based materials, which improved the adhesion between EPS particles and cement-based materials. The mechanical properties of the resulting light weight insulation materials were increased by more than 20%.
- The production process for composite wall panels using EPS particles/foamed concrete as the core material and silicate calcium board as the surface material were obtained, and the panel has a surface density of ≤ 80 kg/m^2 and a thermal transmission coefficient of ≤ 2.0 W/m^2·K for 90 mm thick, with mechanical and thermal properties improved by over 10%.

2 PAPERS

- *Process optimization study of encapsulation method for pretreatment of recycled EPS particles*
- *Influence of slurry characteristics on the bubble stability in foamed concrete*

1 PATENT

- The invention relates to a pretreatment method for EPS particles and a preparation method for EPS particles foamed concrete







1 DEMONSTRATION

Recycled EPS/foamed concrete in composite sandwich panel applied to fabricated buildings



IMPACT

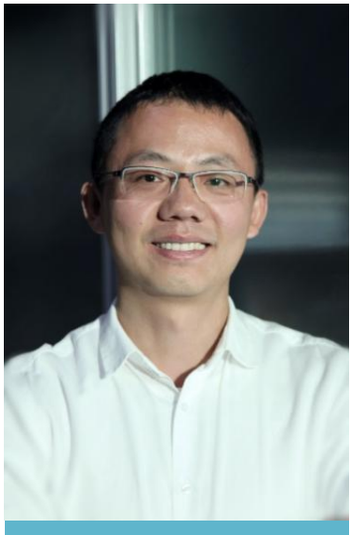
The application of recycled EPS particles/foamed concrete insulation material in composite sandwich wall panels can greatly reducing environmental pollution, and as an eco-friendly green building material that is energy-efficient and cost-effective, it has brought new opportunities for the development of composite wall panels and energy conservation in building. It is an effective way to achieve economic green circular development.

Insulation & Composite Cladding

ONGOING / 80%

2023 TDA 3-2
(JAN 2023 - DEC 2024)

Project Name: Research and Demonstration of Integrated Structural-Insulation Technology in Ultra-low Energy Buildings



PI: Mr. Xiao Ming

BACKGROUND

Vigorously developing ultra-low energy consumption buildings is able to significantly improve building energy conservation efficiencies during their service life and is vital to achieve the targets of "dual carbon". Insulated precast concrete sandwich walls (IPCSWs) is a structural-insulation integrated technology, which realizes the same service life of the insulation system and the main structure. In order to apply IPCSWs in ultra-low energy buildings, it is necessary to comprehensively improve the thermal and combustion performance of the insulation layer, control the wall thickness and their cost and optimize the fiber-reinforced polymer (FRP) connectors.

AIMS AND GOALS

- To study the thermal performance and combustion performance of EPS, XPS, PU and PIR;
- To develop FRP connectors, optimize the mix ratio and manufacture technology, and propose the calculation methods for their tensile and shear capacity, shear-slip model and durability prediction model;
- To form a set of technologies in design-manufacture-construction of precast concrete sandwich facade (PCSF).



PROJECT TEAM

CCTC 中国建科 | 中国建筑标准设计研究院有限公司 CHINA INSTITUTE OF BUILDING STANDARD DESIGN & RESEARCH

同济大学 TONGJI UNIVERSITY

沪誉 HUYUJIANKE

WANHUA

INNOVATIONS

- A low-thermal conducting polyurethane insulation material. The thermal conductivity thermal conductivity of the polyurethane was reduced to 0.020 W/(m^2·K) by optimizing their foam structure and improving the foaming agent and silicone oil system.
- The FRP connectors complied with the guide requirements. The production process for composite wall panels using EPS particles/foamed concrete as the core material and silicate calcium board as the surface material were obtained, and the panel has a surface density of ≤ 80 kg/m^2 and a thermal transmission coefficient of ≤ 2.0 W/m^2·K for 90 mm thick, with mechanical and thermal properties improved by over 10%.

1 DEMONSTRATION

PIR insulation material applied to ultra-low energy buildings in Beijing



1 STANDARD

- Group standard - 'Pre-applied butyl polymer waterproofing membrane

2 PAPERS

- *Experimental study on seismic performance of two-story two-bay precast concrete frame with UHPC-based connections*
- *Out-of-plane response of prefabricated concrete shear walls connected via grouted sleeves*

1 PATENT

- A thermal insulation wall connector

IMPACT

Compared with traditional building walls with exterior insulation, the insulated sandwich walls effectively eliminate falling off the insulation, reduce the fire threats of the walls, reduce the risks of cracking and leakage, and enhance the waterproof performance. Insulation materials and FRP connectors for the integrated structural-insulation exterior walls of ultra-low energy buildings are the key aspects of this project, and the research results will directly motivate and support the research and innovations of petroleum-based materials as well as their promotion and applications in the construction field.

Insulation & Composite Cladding

ONGOING / 50%

2024 TDA-2
(JAN 2024 - DEC 2025)

Project Name: Development and demonstration of polymer aerogel composites

南京工業大學 NANJING TECH UNIVERSITY

安珈新材料 AEGA ADVANCED MATERIALS

BACKGROUND

Development of polymer aerogels is an effective way to overcome the shortcoming of silica aerogels in mechanical property. However, polymer aerogels have poor thermal stability. Hence, phenolic aldehyde-SiO_2 (RF/SiO_2) hybrid aerogel is put forward. The new polymer-based aerogel composite has polymer and SiO_2 networks interpenetrated together, which improves the thermal performance and mechanical property significantly.



AIMS AND GOALS

- To achieve effective construction of the network of the polymer-based aerogel
- To break technical bottleneck of low-cost ambient pressure drying and fast supercritical drying
- To achieve industrial production and practical application of the polymer-based aerogel composites
- To achieve high-valued application of phenolic aldehyde and polymer fibers by polymer-based aerogel products



PI: Dr. Kong Yong

INNOVATIONS

- A new technology based on self-catalyzed in-situ copolymerization of hybrid precursors was developed to prepare polymer aerogels. The reaction system can spontaneously gel under mild conditions facilely without adding any catalyst.
- Phenolic aldehyde and SiO_2 in polymer aerogels hybridize on the molecular scale to form interpenetrating networks, which improves the mechanical, hydrophobic, flame retardant and thermal insulation properties comprehensively.

1 PATENT

A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method and application


检 验 检 测 报 告

皖质检字第2024-GC-0967

样 品 名 称: 酚醛-氧化硅气凝胶复合材料

委 托 单 位: 南京工业大学

受 检 单 位: /

检 验 类 别: 委托检验

国家高分子材料质量检验检测中心(安徽)
安徽省功能高分子材料分析研究有限公司

λ = 0.017 W/(m·K)


BITFR

检测报告

B1 grade of flame retardation

IMPACT

Polymer aerogel composites were developed using resorcinol, formaldehyde, and phenolic resin as precursors of phenolic aldehyde, and 3-aminopropyl triethoxysilane as silica source and “internal catalyst”. The effective construction of aerogel network was realized by illustrating the growth mechanism and regulation method of the network. Based on the development of rapid supercritical drying technology, the high-performance polymer aerogel composites with a thermal conductivity of 0.017 W/(m·K), hydrophobicity of 99%, flame retardation of B1, and excellent mechanical properties were obtained. Other indexes including flatness, compression rebound rate, and water absorption rate meet the requirements of GB/T 34336-2017.

Insulation & Composite Cladding

ONGOING / 50%

2024 TDA-5
(JAN 2024 - DEC 2025)

Project Name: Develop certification for external thermal insulation composite systems (ETICS)

BACKGROUND

ETICS has been widely promoted and applied in China for over 20 years. Up to now, ETICS has some prominent problems. The quality control and management of ETICS has become an important issue.There is no certification system based on the concept of system suppliers. To overcome this drawback, this project focuses on the fabrication of certification system of system suppliers, thus consolidating the quality management and control of ETICS in China.

AIMS AND GOALS

- To establish the certification methods and systems of ETICS;
- To compile the technical specifications and implementing regulations of ETICS certification system;
- To conduct the demonstration of ETICS certification system through related companies.

国检集团

北京工業大學 BEIJING UNIVERSITY OF TECHNOLOGY



PI: Mr. Zhang Jincheng

INNOVATIONS

- The research group closely focused on the ETICS system supplier certification system, clarified the technical capabilities and quality assurance level of system suppliers, and for the first time proposed and clarified the concept of "system suppliers".
- Established technical requirements that can be characterized and evaluated, and established mechanisms that can be identified, traced, and improved. Ensure the continuous and reliable operation of ETICS through a "technology+management" model.
- In the standard, the concept of "compatibility" was first proposed, and clear indicator requirements were put forward.





CSTM 标准化委员会文件

材试标字〔2024〕171 号　　签发人：王海舟

关于CSTM标准《薄抹灰外墙外保温系统认证技术要求》的立项公告

经中国材料与试验标准化委员会（以下简称：CSTM标准化委员会）建筑材料标准化领域委员会审查，CSTM标准化委员会批准CSTM标准《薄抹灰外墙外保温系统认证技术要求》立项，标准项目归口管理委员会为CSTM/FC03/TC21建筑材料标准化领域委员会评价与认证标准化技术委员会，该标准（中文版）立项编号为CSTM LX 0321 01573—2024，标准（英文版）立项编号为CSTM LX 0321 01573—2024 E，标准牵头单位为中国国检测试控股集团股份有限公司，特此公告。

如有单位或个人愿意参与该标准项目的工作，请与项目牵头单位联系。

CSTM 标准化委员会

2024 年 10 月 29 日

Contents
目录

检测与认证

行星运动混凝土搅拌机中叶片磨损对性能的影响及研究 …… 王京侠，杨学军，刘伯敏，魏标，吴杰，赵美萍 75

薄抹灰外墙外保温系统（ETICS）供应商认证制度探索 …… 张金龙，程锦东，金晓冬，贺红旺，艾明亮，武敏，韩元鹏 79

《中小学合成材料面层质量标准》和《中小学合成材料面层施工标准》标准物理机械性能解读 …… 吴佳纲，李萍，程佳瑞，卢丽英，贾艳江，陈鹏程，董建华，冯彩丽，李鹏 83

直读式荧光法石灰质量快速方法研究 …… 王禹，赵红梅 86

技术与应用

低温变形条件下检测中几种典型缺陷的分析与研究 …… 赵鹏，蔡伟杰，吴成成，马悦，陈雨薇，郭嘉嘉 91

自密实混凝土转动扭离状及性能研究 …… 吕金峰，徐书飞，庄昭杰，周正，曾昌，生西平 95

水下纸件含氯知识系统运用问题分析与对策标准 …… 刘志强，孟春欣，李生雪，张猛，陈雨佳，陈国庆 99

黄土场料质基体实质量快速检测技术控制标准 …… 陈龙，王国锦，杨晓礼，张慧欣 102

墙体材料基层质量检验技术研究 …… 李亮，周洋，周京超，杜静，肖轩，郭慧，李松涛 107

经验交流

模块化装成建筑发展研究 …… 吴星海，李佳润，罗彦恩，杨威，魏宏亮 110

双碳目标下发电行业碳价格波动特征分析 …… 王成元，谭乐，马廷民，张晓义，张小龙 114

基于高强自密实混凝土的隧道仰拱施工质量控制 …… 杨波然，宋海有 118

水泥窑协同处置危险废物熟盐炉技术应用及旋流位置温域改造研究 …… 程锦东，卜军，田可可，付国凯 123

1 PAPER

- *External Thermal Insulation Composite Systems (ETICS) supplier and its certification method*

IMPACT

The ETICS certification technical specification is the first certification rule for external wall insulation systems in the industry to propose the concept of system suppliers, which can improve the construction technology and quality management level of the industry. From the dual perspectives of "technology" and "management", make the exterior wall insulation industry more specialized, standardized, and regulated. The successful implementation of this project will contribute to the continuous improvement and risk tracing control of ETICS quality, and promote the healthy and stable development of China's building energy-saving industry.

Insulation & Composite Cladding

ONGOING / 50%

2024 PHD-5
(JAN 2024 - DEC 2026)

Project Name: Surface modification of extruded polystyrene foam and the study of itsflame retardancy and adhesion performances

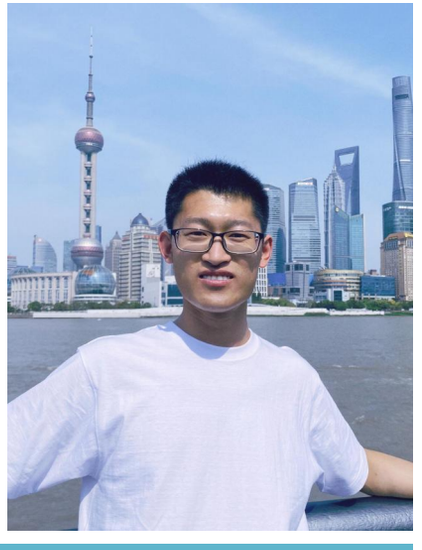
BACKGROUND

The XPSF used in external thermal insulation composite systems is extremely flammable and poorly bonded with adhesive mortar. Traditional addition of flame retardants and application of surfactant affect the performance of XPSF and the convenience of construction. Therefore, the UV curable coating is innovatively prepared to improve both these performances simultaneously. The modification coating is efficient, environmentally friendly and convenient, promoting the secure application of XPSF.

北京工業大學
BEIJING UNIVERSITY OF TECHNOLOGY

AIMS AND GOALS

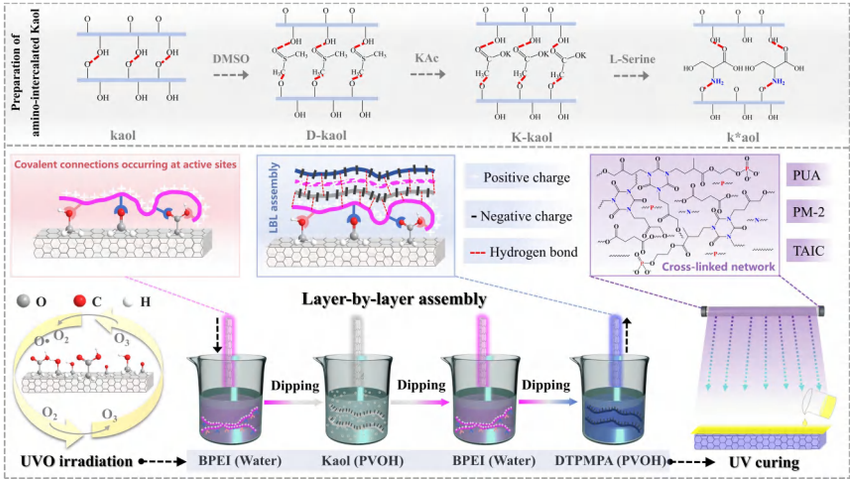
- To obtain multifunctional UV curable systems by preparing new P-N synergistic flame retardant monomers and hollow nanoparticles containing transition metals.
- To investigate the flame retardant performance and mechanism of XPSF modified with UV coating.
- To study the bonding behavior and mechanism between modified XPSF with adhesive mortar.



PhD Student: Wang Wanfu

INNOVATIONS

- UV curable polyphosphonic acid flame retardant monomer was synthesized and introduced into UV coatings to improve the flame retardancy of extruded polystyrene (XPSF).
- The bonding strength between XPSF and adhesive mortar was enhanced by the surface modification of flame retardant UV coatings.
- With the application of organic-inorganic composite UV coating via the introduction of 2% hollow LDH nanoparticles, the flame retardancy of XPSF was further improved.



1 CONFERENCE PRESENTATION

- Synthesis of Fe-MOF flame retardant synergist and its application in flame retardant PS



1 PAPER

- *Self-assembled coatings with durable flame retardancy for EPS foam*

IMPACT

- The flame retardancy of XPSF and interface bonding strength of XPSF/mortar are simultaneously improved via the application of organic-inorganic UV coatings.
- The project achievements can effectively simplify the construction process of exterior wall external insulation system and reduce the negative impact of flame retardants to the environment.
- This work provides guidance for improving the safety and environmental friendliness of organic foam insulation material for building.



PART 4

ADVOCACY

ADVOCACY 2024

2 Conferences
Co-organized & sponsored international conferences with 700+ participants



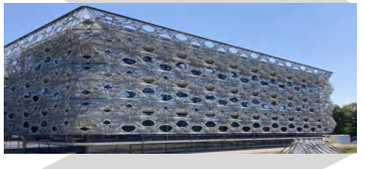
7 Series of Forums
Organized 7 forums with 40,000+ viewers



24 Conference Speeches
Delivered 24 speeches by NEXCEL to the public with 5,000+ audiences



140 Articles
With 4,300 followers and 200,000+ views of social media account



5 Memorandum of Understanding
Signed strategic cooperation agreements with 5 institutions



32 Outreach Meetings
Organized outreach activities with 32 institutions



SPONSORED CONFERENCE

International Conference on Building Materials (ICBM2024) & Non-metallic for Sustainable Infrastructure Forum in Hanoi, Vietnam













Conference on High-Quality Development of Concrete and Cement Products

NEXCEL SERIES FORUMS 2024



7 Forums **36 Presentations** **40,000+ Viewers**

aramco 沙特阿美 | CNBM | CBMA | 清華大學 Tsinghua University | 北京工業大學 Beijing University of Technology | 哈爾濱工業大學 Harbin Institute of Technology | 交通运输部公路科学研究院 Research Institute of Highway Ministry of Transport | China National Building Waterproof Association

MEDIA RELEASE 2024

140 Articles

4,300+ Followers

200,000+ Views



88 NEXCEL Activity News



30 Project Outcomes



10 Industry News



12 Interviews with PIs

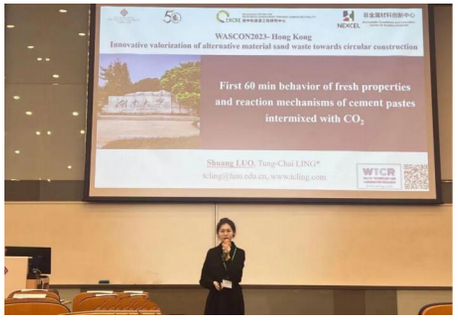
EVENT
2024

5 Speeches Given by NEXCEL Team to the Public		
Presenter	**Topic**	**Event**
Li Juan	Development of NEXCEL	Concrete and Cement Products Industry Sci&Tech Innovation Forum
Yao Yan	Research of Cement and Concrete in China	Conference on High-Quality Development of Concrete and Cement Products
Li Juan	Non-metallic Materials - Sustainable Concrete Solutions	
Li Juan	Sustainable Concrete Solutions	International Conference on Building Materials (ICBM2024)
Li Juan	Sustainable Concrete Solutions	Seminar of Shandong Provincial Key Laboratory of Preparation and Measurement of Building Materials in University of Jinan













EVENT

19 Speeches Given by Project Teams to the Public		
Presenter	**Topic**	**Event**
Zhou Hemin	Mixed alkali-zinc effects on thermo-mechanical properties in borosilicate glasses	International Commission on Glass Annual Meeting 2023 (ICG 2023)
Luo Shuang	Improving the Mechanical Properties of Portland Cement via Blended CO_2-intermixed High Belite Calcium Sulfoaluminate Cement	The 1st RILEM International Conference on Mineral Carbonation for Cement and Concrete (1st MC3 2024)
Wang Zhendi	Research on 3D Printed Polymer Modified Concrete and Its Interface Enhancement Technology	Conference on High-Quality Development of Concrete and Cement Products
Wang Jingsheng	Synthesis of Phosphorus-Metal-Imidazole Complexes as Latent Flame-retardant Curing Agents and Their Impact on the Curing and Flame-retardant Properties of Epoxy Resin	The 5th National Symposium on Functional Polymer Materials
Wu Zihao	Preparation and Mechanism of Carbon black/Cement-based Electromagnetic Wave Absorbing Materials with Multi-mechanism	The 3rd China Metamaterials Conference
Liu Tianqiao	Pultruded FRP Composites: Manufacturing-material-structure integrated design method	The 8th Conference in Manufacture and Applications of Pultruded FRP Composites
Hu Quanchao	Development and Application for TPO Waterproofing Sheets with High Flame Retardancy and Long Service Life	The 5th Waterproof Industry Conference 2024 & The 18th Single ply Roof Technology and Market Seminar
Xiao Ming	Research and Demonstration on Integrated Structural-Insulation Wall	The 2024 International Zero Carbon Conference and The 2024 China Windoor Facade Technology Innovation Conference
Zhang Junjie	Quantitative Characterization of the Blending and Diffusion of Virgin and Reclaimed Asphalt in Recycled Asphalt Mixtures	The World Transportation Convention 2024 (WTC2024)
Yang Bin	Characterization of Diffusion of Surface Treatment Emulsion in Aged Asphalt Binder of Porous Asphalt Mixture through SEM/EDS Analysis	
Liu Jiarong	Electrical Conductivity and Piezoresistive Response of CFRCM with ICCP	The 10th Conference of the Asian Concrete Federation
Long Guangcheng	Performance Evolution of Concrete under Low Vacuum Environments	JIPR-ACF WEBINAR SERIES lecture
WANG Zhendi	3D Printing Cement-based Materials	International Conference on Building Materials (ICBM2024)
HU Chuanlin	Research and Application of Graphene in Concrete	
WANG Qianqian	Properties and Demonstration of Asphalt Mixtures Incorporating High Volumes of Recycled Plastics	
XUE Tong	Investigation on the Synthesis and Characteristics of a Novel Polycarboxylate Superplasticizer	
LIU Tianqiao	Carbon Emissions of High-performance Pultruded FRP Composite Structures	
LING Tungchai	Enhancing CO_2 Sequestration in the Cement Concrete Life Cycle: Strategies for Optimization	
LI Chenggao	Preparation and Properties of High Performance Fiber Reinforced Thermoplastic Bending Rebars	

NEW STRATEGIC PARTNERSHIP

International Union of Laboratories and Experts in Construction Materials, Systems and Structures

CCPA
中国混凝土与水泥制品协会
China Concrete & Cement-based Products Association

NEXCEL

Hanoi University of Civil Engineering

China National Building Waterproof Association

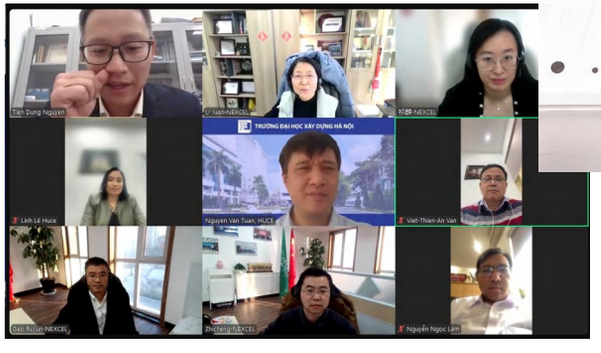
CIEEMA 中国绝热节能材料协会
China Insulation & Energy Efficiency Materials Association

OUTREACH 2024

10 Universities
Hanoi University of Civil Engineering
Wuhan University of Technology
Universität Siegen
Southwest University of Science and Technology
Southeast University
University of Jinan
Macau University of Science and Technology
Tongji University
Hubei Engineering University
Yantai University













5 Research Institutes
National and Local Unified Engineering Research Center for Basalt Fiber Production and Application Technology
Yangtze River Delta Carbon Fiber & Composite Innovation Center
Vietnam Institute for Building Materials
Nanjing Hydraulic Research Institute
The Academy of Athens

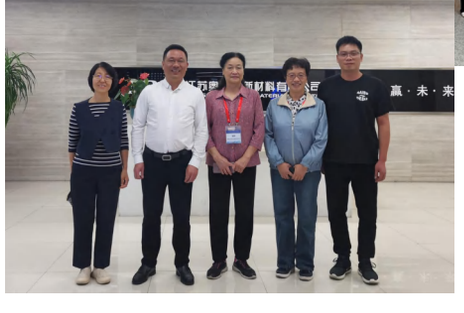
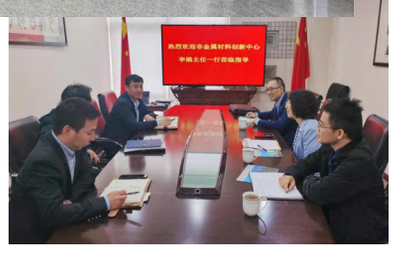
OUTREACH

4 Associations
International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM)
China Concrete and Cement-based Products Association
China National Building Waterproof Association
China Insulation & Energy Efficiency Materials Association







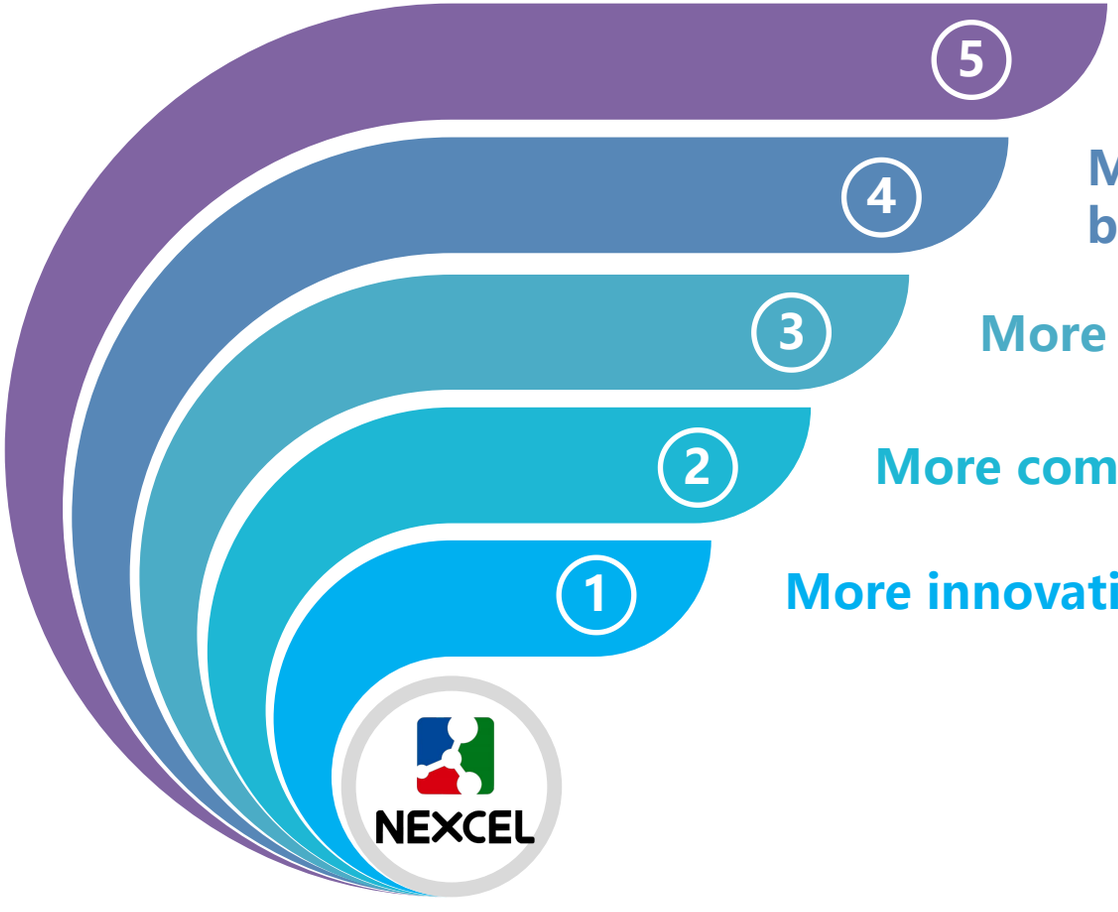

13 Producers & End-users
Liaoning Kelong Fine Chemical
Oriental Yuhong
CNBM Beijing New Building Materials Public Limited Company
OCEANPOWER New Material Technology
HICOMA
CNBM Zhongyan Technology
China Testing & Certification International Group
McCANN WORLDGROUP
Beijing Qin Tian Sci&Tech Group
Beijing Construction Engineering Group Advanced Construction Materials
ZCONE
ARIT
WEIDUN Cement Group



PART 5

OUTLOOK

THE WAY FORWARD



5. More contribution to low-carbon development
4. More sustainable non-metallic bulding solutions
3. More promotion across the globe
2. More commercial applications
1. More innovative project outcomes

ULTIMATE GOALS

HIGH PERFORMANCE

LOW CARBON

SUSTAINABILITY



3Rs:

REDUCE

REUSE

RECYCLING



PART 6

APPENDIX

APPENDIX

Milestone

NEXCEL convened the Fifth Steering Committee Meeting
JAN 10 2024

NEXCEL convened its Fifth Steering Committee (SC) Meeting on January 10, 2024. During the meeting, the SC members had a comprehensive review of the 2023 Annual Report and 2024 Business Plan, and approved the 'Recommended List of Proposals for 2024 Program', which had been recommended by the TAC Task Force and consisted of a total of 22 projects.



NEXCEL convened 2023 Project Interim Review Meeting
JAN 22 2024

NEXCEL convened Interim Review Meeting for the 2023 TDA projects. The meeting was attended by the Principal Investigators and key members of six projects who provided a detailed presentation on the latest progress and significant achievements. The Review Panel conducted rigorous reviews and posed professional inquiries to each project.



NEXCEL convened 2024 Project Inception Meeting in Beijing
JAN 24, 2024

NEXCEL announced the list of 2024 Funded Projects and the winners of Ph.D Scholarship, and convened Project Inception Meeting in Beijing. More than 40 participants attended the meeting. During the meeting, the Principal Investigators presented respectively on the detailed technical approach and research plan, and the expert panel fully affirmed the innovation and feasibility of projects and put forward specific suggestions on the project implementation.



NEXCEL convened the workshop on FRP in Beijing
MAR 27, 2024

NEXCEL convened the Project Planning Workshop on Fiber Reinforced Polymer (FRP) Composite Materials in Beijing. The member of Chinese Academy of Engineering, Chairman of CBMA, and over 10 top experts in the FRP sector were presented. Through this workshop, new and existing challenges in the application of FRP composites were identified and well-targeted recommendations were provided. NEXCEL will gather and leverage the recommendations, as well as commit to the improvement of the application system for FRP composites.



NEXCEL convened the workshop on Nonmetallic Materials in Beijing
APR 7, 2024

NEXCEL convened the Project Planning Workshop on special concrete, pavement, construction chemicals, waterproofing, and insulation materials in Beijing. The member of Chinese Academy of Engineering(CAE), Chairman of CBMA, and over 10 top experts were presented. Through this workshop, the advantages and potential in the application of nonmetallic materials on NEXCEL'S focus areas were identified and well-targeted recommendations were provided. NEXCEL will summarize the recommendations and commit to the improvement of the application of nonmetallic materials. During the meeting, Prof. Liu Jiaping, the member of CAE, was appointed as NEXCEL Strategic Consultant.



Milestone

2022 TDA & 2023 SFP projects conclusion
AUG 5, 2024

NEXCEL convened the Project Concluding Meeting for 4 TDA projects in 2022 and 4 SFP projects in 2023. NEXCEL Technical Advisory Committee(TAC) members and Technical Committee(TC) members conducted technical reviews on project outcomes and final reports. Meanwhile, Aramco TAC members conducted letter review of the project final reports, providing constructive comments and suggestions on key aspects.



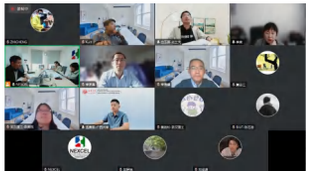
NEXCEL won the “Green Impact Award”
OCT 12, 2024

The 8th Session of the 8th Council Meeting of Concrete Admixture Branch of China Building Materials Federation and the Concrete Admixture Science and Technology Forum was held in Nanjing. With the outstanding contribution to concrete admixture industry, NEXCEL won the “Green Impact Award”, and Dr. Li Juan, Program Director of NEXCEL, won the “Green Impact Champion", highlighting the great impact of NEXCEL on the concrete admixture industry.



2024 SFP projects mid-term review
NOV 6, 2024

NEXCEL convened the Mid-term Review Meeting for the 2024 Small Fund projects. Project Principal Investigators and key members of 4 projects attended this meeting and gave detailed presentations on the latest research progress, important outcomes and future work plan.



NEXCEL convened 2024 TDA Project Mid-term Review Meeting
JAN 16, 2025

NEXCEL convened the Mid-term Review Meeting for the 2024 TDA projects. The Principal Investigators and key members of 5 TDA Projects attended the meeting and reported the latest progress and outcome of the projects. The review panel, with their extensive experience and insightful perspectives, conducted rigorous reviews and posed professional inquiries to each project.



APPENDIX

Project Demonstrations

Application of recycled EPS/foam concrete composite sandwich panels in building energy-saving renovation

Recycled EPS/foam concrete composite sandwich panels, the outcome of 2022 NEXCEL SFP Project, implemented by South China University of Technology, has been successfully applied on building energy-saving renovation project in Guang Zhou, which expands the prospects for reusing discarded EPS materials in thermal insulation wall panels, thereby contributing significantly to the sustainable development of low-carbon and energy-efficient construction.



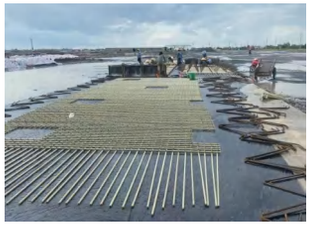
Application of TPO waterproofing membrane in Western (Chongqing) Science City

Thermoplastic polyolefin (TPO) waterproofing membrane, developed by Keshun Waterproof Technology (Keshun), has been applied to the Science Hall of Western China (Chongqing) Science City. It is the outcome of 2023 NEXCEL TDA project 'Development and engineering demonstration for thermoplastic polyolefin waterproofing sheets with high flame retardancy and long service life.' Keshun has successfully installed over 100,000 square meters of TPO waterproofing membranes on the roof of the Science Hall. The TPO membrane has a polymer content exceeding 70%, and the amount of polyolefin used per square meter of the membrane is 1.6 kilograms, resulting in a total polyolefin consumption of over 160 tons for the project.



Application of FRP rebars to Lach Huyen Port in Vietnam

In the northern Vietnamese city of Haiphong, the Lach Huyen port project is currently under construction. The reinforcement used in this project are not traditional steel rebars, but fiber-reinforced polymer (FRP) rebars supplied by Jiangsu Chemlead New Material Co Ltd., a project partner of NEXCEL. The challenge that needs to be addressed in marine engineering is insufficient structural safety and durability caused by the corrosion of steel rebars. By using FRP rebars with lightweight, high-strength and corrosion-resistant to replace steel rebars, the durability of concrete structures can be significantly improved in the marine environment, to have a design life of not less than 50 years without maintenance and achieve energy saving and low carbon in the whole life cycle. FRP rebars are designed for the pavement and bridge to tackle the problem of easy corrosion under marine environment, and six different sizes of FRP longitudinal bars and stirrups are used in this project. The Lach Huyen port is the largest and the most developed container port in Vietnam. At present, the project is still under construction, and 240 tons of FRP rebars have been used. The project is expected to be completed in June 2025.



Application of FRP communication tower built in Guangdong

FRP communication tower developed by Harbin FRP Institute under CBMA, was built in Guangdong Province. It is the outcome of NEXCEL 2022 TDA 4-1 project 'Development and demonstration of composite lattice tower for communication and power transmission over 15m'. The project team designed a FRP tower with a height of 18 meters and a total weight of 1.5 tons. it reduced the weight by 50% compared with the steel tower, with polymer accounting for 27% and a total weight of 405 kg. The footprint area of the tower is 6.25 m2, which requires a rooftop with a bearing capacity of 240 kg/m2. Compared with traditional steel towers of the same height, composite towers can reduce carbon emissions by 43%. Furthermore, less maintenance makes it cost-effective throughout its entire life-cycle.

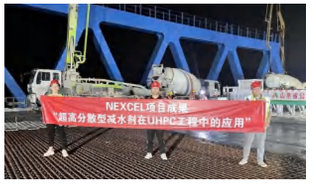


Project Demonstrations

APPENDIX

Application of ultra-highly dispersing PCE for UHPC to a grand bridge

Ultra-highly Dispersing Polycarboxylate Superplasticizer(PCE) for Ultra-High Performance Concrete(UHPC), the outcome of NEXCEL 2022 TDA3-1 Project has been successfully demonstrated in the deck paving of Xiaoqinghe Grand Bridge in Shandong Province. The Bridge is 1230.5m long and 33m wide with eight lanes. It has an orthotropic steel deck structure with a top plate thickness of 14mm. The development of ultra-highly dispersing PCE by the project team enables UHPC to achieve an initial flow of 720mm, improving the workability of UHPC, increasing the compressive strength to 135MPa, and fully meeting the engineering requirements of the Xiaoqinghe Grand Bridge pavement project. In this bridge pavement project, 25t of super-dispersant PCE was used, which can reduce CO2 emissions by 20%.



A production line of phase change energy storage composite particles for asphalt pavement was built

An annual production of 60,000 tons phase change energy storage composite particles production line was built in Shaanxi Hancheng Sci&tech Innovation Park, which was an outcome of NEXCEL 2024 SFP project ‘Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture’. With intelligent and environment friendly operation process, the self-developed production line has been recognized as "2025 Green Manufacturing Engineering Project".



Asphalt mixtures incorporating large amount of recycled plastics applied to the road reconstruction project

The outcome of NEXCEL 2023 SFP project 'Effects of recycled plastics on the performance of asphalt mixture', implemented by Nanjing Tech University, has been successfully demonstrated in the road reconstruction and expansion project in Suqian, Jiangsu. A total of 9.8 tons of recycled thermoplastic and 23.6 tons of recycled thermosetting plastic filler were utilized, resulting in cost savings of 14.5% for asphalt and 41.4% for fillers, while significantly reducing CO2 emissions.



PIR insulation material applied to ultra-low energy buildings in Beijing

The novel PIR insulation material, the outcome of NEXCEL 2023TDA project ‘Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings’, was successfully applied to Guoyue Tiansheng residential project, which is the first ultra-low energy residential community in Miyun, Beijing. The total construction area of this project is 67,000 m2. Ultra-low energy buildings adapt to climate characteristics and site conditions, minimize building heating, air conditioning and lighting requirements through passive building design, maximize energy equipment and system efficiency through active technical measures, and provide a comfortable indoor environment with minimal energy consumption.Through the application of ultra-low energy building technology, the energy consumption level of the project is equivalent to 94% of the relative energy saving rate of buildings in China, and the entire project can reduce more than 400 tons of CO2 throughout the year.



APPENDIX

Conferences & Forums Sponsored by NEXCEL

Conference on High-Quality Development of Concrete and Cement Products, sponsored by NEXCEL, held in Wuhan
APR 26, 2024



Conference on High-Quality Development of Concrete and Cement Products was held in Wuhan. With the theme of "Green and Low-carbon, Energy Saving and Environmental Protection, Digital Intelligent Manufacturing", the conference invited 9 renowned experts to deliver keynote speeches at the general meeting, and 36 experts to give invited speeches at three parallel seminars to exchange innovative outcomes, cutting-edge material research and latest applications, jointly promoting the sustainable and high-quality development of the concrete and cement products industry. The conference was attended by over 200 participants from research, testing, design and consulting institutions, universities, and firms.

NEXCEL Forum on Nonmetallic for Sustainable Infrastructure was held in Hanoi, Vietnam
NOV 2, 2024



The International Conference on Building Materials 2024 (ICBM2024) was held in Hanoi, Vietnam. Under the auspices of the Ministry of Construction of Vietnam (MOC), this conference was organized by Vietnam Institute for Building Materials (VIBM) and co-organized by CBMA and NEXCEL, and it attracted more than 300 participants from all over the world. During ICBM2024, NEXCEL organized the Forum on "Nonmetallic for Sustainable Infrastructure" on NOV 2. This forum was co-chaired by Dr. Mai Ngoc Tam, Vice President of the VIBM, and Dr. Li Juan. 8 NEXCEL project Principal Investigators shared their latest research outcomes and practical experience in the field of nonmetallic materials for sustainable infrastructure.

Organized NEXCEL 2023 Series Forum
OCT-DEC, 2024



NEXCEL Series of Forum 2024 consisted of one Product & Technology Launch Forum and six forums on Concrete Admixtures, FRP Rebars and Cables, FRPs for Civil Engineering, Aerogel Composites, Pavement Materials and Waterproofing Materials. 36 top scholars and experts from universities, institutes and companies were invited to share their academic insights and practical experience, and six salons were also organized after the presentations.



- NEXCEL Products & Technologies Launch Forum
- Forum on Concrete Admixtures
- Forum on FRP Rebars and Cables
- Forum on FRPs for Civil Engineering
- Forum on Aerogel Composites
- Forum on Pavement Materials
- Forum on Waterproofing Materials

Speeches Given by NEXCEL

APPENDIX

NEXCEL attended 2023 Concrete and Cement Products Industry Sci&Tech Innovation Platform Exchange Forum
MAR 9, 2024

The 2023 Concrete and Cement Products Industry Sci&Tech Innovation Platform Exchange Forum was held in Ningbo, Zhejiang. A total of 16 industry key laboratories, technology centers, and innovation platforms participated in the forum. Dr. Li Juan, Program Director of NEXCEL, was invited to present the NEXCEL Development Report. This forum expanded the application of FRP materials in concrete and cement product engineering, as well as promoted high-quality, sustainable, and low-carbon development in the industry.



NEXCEL attended the Forum on Application of FRP in Building Area in Harbin
MAR 31, 2024

Harbin FRP Institute hosted a forum titled "Application of FRP in Building & Construction area." Over 60 experts participated in the forum and over 900 audience attended online. Dr. Li Juan, Program Director of NEXCEL, was invited to give a presentation on sustainable FRP solutions in building & construction area. NEXCEL Technical Committee Members and project principal investigators were also invited to deliver presentations on CFRP cable, engineering application of FRP and 3D printing concrete.



NEXCEL Ph.D student Luo Shuang gave a presentation in "1st MC3 2024"
APR 16, 2024

From April 16th to 17th, 2024, the 1st RILEM International Conference on Mineral Carbonation for Cement And Concrete (1st MC3 2024) was held in Aachen, Germany. The conference attracted over 160 representatives from 25 countries. Prof. Ling Tung-Chai from Hunan University, the principal investigator of the NEXCEL 2023 Ph.D. project and Ms. Luo Shuang, the Ph.D. candidate, attended the conference and delivered a presentation entitled "Improving the Mechanical Properties of Portland Cement via Blended CO2-intermixed High Belite Calcium Sulfoaluminate Cement.



NEXCEL Ph.D student Wang Jingsheng gave a presentation in "5th National Symposium on Functional Polymer Materials"
APR 27, 2024

From April 27 - 28, 2024, the 5th National Symposium on Functional Polymer Materials and the 1st Innovation Academic Forum on Dynamic Covalent Driven Polymer Materials were held in Mianyang, Sichuan. The conference attracted over 500 representatives from the academic and industrial sectors to discuss the innovation and development of functional polymer materials. NEXCEL 2024 PH.D student Mr. Wang Jingsheng from Wuhan University of Technology attended the conference and delivered a presentation titled 'Green Synthesis of Phosphorus-Containing Imidazole Derivatives and Their Flame Retardancy and Curing Characteristics in Epoxy Resin Systems'.



NEXCEL Ph.D student Wu Zihao gave a presentation on “The 3rd China Metamaterials Conference”
MAY 9, 2024

The Third China Metamaterials Conference was successfully held in Wuzhen, China. The conference attracted over 3,000 representatives from academia and industry to jointly discuss the innovation and development of metamaterials. Mr. Wu Zihao, Ph.D. candidate from Wuhan University of Technology and Principal Investigator of NEXCEL 2024 PHD project, gave a presentation titled ‘Research on the construction and functional mechanism of lightweight absorbent materials based on secondary aluminum ash foamed cement’ on the conference.



APPENDIX

Speeches Given by NEXCEL

NEXCEL Project PI Prof. Liu Tianqiao gave a presentation in the 8th Conference in Manufacture and Applications of Pultruded FRP Composites
MAY 22, 2024

The 8th Conference in Manufacture and Applications of Pultruded FRP Composites was successfully held in Funing. Prof. Liu TianQiao from Beijing University of technology, Principal Investigator of NEXCEL 2022 TDA Project, gave a presentation entitled 'Pultruded FRP Composites: Manufacturing-material-structure' integrated design method.'



NEXCEL Project PI Hu Quanchao gave a presentation in the 5th Waterproof Industry Conference 2024 & The 18th Single ply Roof Technology and Market Seminar
MAY 28, 2024

The Fifth Waterproof Industry Conference 2024 & The 18th Single ply Roof Technology and Market Seminar were held in Nanjing, attracting over 1,000 representatives. Mr. Hu Quanchao, R&D Manager of Keshun and Principal Investigator of NEXCEL 2023 TDA Project, delivered an invited speech on 'Development and application for thermoplastic polyolefin (TPO) waterproofing sheets with high flame retardancy and long service life.'



NEXCEL Project PI Xiao Ming gave a presentation entitled 'Research and Demonstration on Integrated Structural-Insulation Wall'
MAY 28, 2024

During May 26-28, 2024, The 2024 International Zero Carbon Conference and The 2024 (3rd) China Windoor Facade Technology Innovation Conference (CWTIC 2024) , organized by China Association of Building Energy Efficiency, were held in Beijing. Mr. Xiao Ming, Deputy Chief Engineer of China Institute of Building Standard Design & Research and Project Principal Investigator (PI) of NEXCEL TDA Project 'Research and demonstration on thermal insulation and structure integration technology for ultra-low energy buildings', gave a presentation titled 'Research and Demonstration on Integrated Structural-Insulation Wall.'



NEXCEL Ph.D student Zhang Junjie & Yang Bin gave presentations on 'The World Transportation Convention 2024'
JUN 26, 2024

The World Transportation Convention 2024 (WTC2024), co-hosted by six institutions, was successfully held in Qingdao, China. Under the theme of "New Transportation in Change", the WTC2024 attracted thousands of representatives from academia and industry in China and abroad to discuss innovation and development in the field of transportation.

Zhang Junjie from Harbin Institute of Technology, Principal Investigator of NEXCEL 2024 PHD project 'Research on the Composite Aging Mechanism and Phase Structure of SBS-Modified Asphalt Multiphase Systems,' delivered a presentation titled 'Quantitative Characterization of the Blending and Diffusion of Virgin and Reclaimed Asphalt in Recycled Asphalt Mixtures.'

Mr. Yang Bin from the Hong Kong Polytechnic University, the Principal Investigator of NEXCEL 2024 PHD project 'Preventive Maintenance Material Design and Multiscale Characterization of its Working Mechanism for Porous Asphalt Pavement', delivered a presentation titled 'Characterization of Diffusion of Surface Treatment Emulsion in Aged Asphalt Binder of Porous Asphalt Mixture through SEM/EDS Analysis'.



Speeches Given by NEXCEL

APPENDIX

NEXCEL Ph.D student Liu Jiarong gave a presentation in "ACF 10th Conference"
AUG 15, 2024

Liu Jiarong, Ph.D student from Zhejiang University and the principal investigator of NEXCEL 2024 Ph.D project titled "Research on Multifunctional Carbon Fabric Reinforced Seawater Sea-sand Concrete Composite Member System", gave a presentation titled "Electrical Conductivity and Piezoresistive Response of CFRCM with ICCP" in the 10th Conference of the Asian Concrete Federation (ACF 10th Conference). At the conference, Ph.D student Liu Jiarong provided a detailed overview of the effect of ICCP on the mechanical properties, electrical conductivity, and piezoresistive effect of CFRCM. Liu also presented future research prospects and engaged actively with scholars, receiving unanimous recognition from the attending researchers.



Dr. Li Juan delivered a keynote speech at University of Jinan
SEP 8, 2024

Dr. Li Juan, Program Director of NEXCEL, was invited to deliver a keynote speech entitled "Sustainable Concrete Solutions" at Shandong Provincial Key Laboratory of Preparation and Measurement of Building Materials in University of Jinan. She introduced sustainable concrete solutions from three perspectives: FRP rebar, polymer-modified concrete, and new admixtures to address the technical challenges in concrete for high durability, long service life and sustainability.



NEXCEL Project PI Prof. Long Guangcheng gave a presentation entitled ‘Performance evolution of concrete under low vacuum environments’
SEP 16, 2024

Prof. Long Guangcheng, Principal Investigator of NEXCEL 24TDA-1 project, delivered a presentation at the JIPR-ACF WEBINAR SERIES lecture. The main topic of the lecture was "Advanced Cementitious Materials: Next-Generation Sustainable and Resilient Infrastructure: Multiscale Understanding and Enabling Technologies." Prof. Long shared the latest progress on the performance evolution of cement-based materials in low vacuum environments. The presentation not only showed the cutting-edge results of Prof. Long's team in concrete under low vacuum conditions but also provided valuable references for researchers in related fields.



APPENDIX

Strategic Partnership

NEXCEL signed MOU with China National Building Waterproofing Association
APR 10, 2024

On April 10, 2024, a signing ceremony for the Memorandum of Understanding (MOU) between NEXCEL and China National Building Waterproofing Association was held in Beijing. Both parties will establish a strong long-term partnership on developing projects, sharing resource, co-orgnizing conference, and building media platform to improving the application of hydrocarbon-based materials in the field of construction waterproofing.



NEXCEL signed an MOU with China Concrete and Cement-based Products Association
May 31, 2024

On May 31, 2024, NEXCEL and China Concrete and Cement-based Products Association (CCPA) signed a Memorandum of Understanding (MOU), which marks that both parties will engage in a strong collaboration, jointly promoting nonmetallic materials innovation and application in the concrete and cement products area. During the signing ceremony, Dr. Li Juan, Program Director of NEXCEL, introduced an overview of NEXCEL and the strategic vision for collaboration with CCPA.



NEXCEL Signed an MOU with China Insulation & Energy Efficiency Materials Association
DEC 18, 2024

NEXCEL and China Insulation & Energy Efficiency Materials Association (CIEEMA) signed a Memorandum of Understanding (MoU) at the 2024 CIEEMA Annual Conference in Tianjin. Dr. LI Juan, Program Director of NEXCEL, and Prof. HAN Jixian, Executive President of CIEEMA, signed the MoU on behalf of the two sides. Both parties view this signing as a chance to create a lasting and stable cooperation relationship. They will collaborate on resource sharing, product development, event organization, and project promotion, aiming to enhance and expedite research innovation and engineering applications of nonmetallic materials in building energy efficiency and insulation.



NEXCEL and RILEM signed International Partner Agreement
DEC 5, 2024

Recently, NEXCEL and the International Union of Laboratories and Experts in Construction Materials Systems and Structures (RILEM) signed an International Partner Agreement (IPA), in order to share opportunities of research development, recommendation formulation, technological application and promotional activities in the field of nonmetallic materials. Prof. Nele De Belie, RILEM President, and Dr. Li Juan, Program Director of NEXCEL, signed this agreement on behalf of both parties. Both sides will take the IPA signing as an opportunity to establish a long-term and stable cooperation mechanism, carry out cooperation in resource sharing, project developing, joint events and technical promotion, thus to expand and accelerate the excellence and engineering application in nonmetallic materials and construction.



NEXCEL and HUCE signed International Partner Agreement
JAN 10, 2025

NEXCEL and the Hanoi University of Civil Engineering (HUCE) signed an International Partner Agreement (IPA), in order to share opportunities of research development and international cooperation in the field of nonmetallic materials. Dr. Li Juan, Program Director of NEXCEL, and Prof. NGUYEN Hoang Giang, Vice Rector of HUCE, signed this agreement on behalf of both parties. Both sides will take the IPA signing as an opportunity to establish a long-term and stable collaborative relationship. Through resource sharing, project developing, conference co-organizing, and technical application, both sides aim to advance industrial upgrading, expand market opportunity, raise public awareness, and jointly accelerate the research innovation and engineering application of nonmetallic materials in ASEAN countries.



Outreach

NEXCEL outreach meetings with industry associations and enterprises
FEB, 2024

NEXCEL conducted outreach activities with industry associations and renowned enterprises, engaging in discussions and collaborations regarding the promotion and application of nonmetallic materials in the building and construction sector.

- China Concrete and Cement-based Products Association visits NEXCEL
- Liaoning Kelong Fine Chemical visits NEXCEL
- Beijing New Building Materials Public Limited Company
- Oriental Yuhong

NEXCEL visited Beijing Qin Tian Sci&Tech Group
APR 12, 2024

NEXCEL team paid a visit to Beijing Qin Tian Sci&Tech Group (BJQT) and exchanged views on the development progress of NEXCEL 2024 SFP Project 'Research and demonstration on snow and ice melting property of phase change energy storage asphalt mixture'. After the meeting, NEXCEL team visited the production workshop and lab for phase change energy composite particles.

NEXCEL visited BcegACM
APR 23, 2024

NEXCEL team visited Beijing Construction Engineering Group Advanced Construction Materials (BcegACM). Both sides had exchanges on the production and application of aerogel and FRP doors and windows, and spoke the willingness to strengthen cooperation on the upcoming projects to improve the application of aerogel in building and construction area.

University Siegen (Germany) visited NEXCEL
MAY 11, 2024

On May 11, 2024, Prof. Zhang Chuanzeng from University Siegen (Germany), Prof. Xiao Jianzhuang, Vice President of Guangxi University, and Prof. Ji Zhijiang from CBMA visited NEXCEL, and exchanged views on NEXCEL Innovation Program. They praised the outcomes of NEXCEL and provided well-targeted recommendations for the future work.

OCEANPOWER New Material Technology visited NEXCEL
MAY 17, 2024

On May 17, 2024, Mr. Gao Yunlong, Chairman Assistant of OCEANPOWER New Material Tech and Secretary General of Subcommittee on Asphalt Concrete of National Technical Committee 458 on Concrete of Standardization Administration of China, and Mr. Zhao Pu, Cheif Engineer visited NEXCEL. Both sides had exchanges on the development, standardization and low-carbon techinology of FRP and asphalt concrete.



APPENDIX

Outreach

Nanjing Hitech Composites visited NEXCEL
MAY 21, 2024

On May 21, 2024, Mr. Chen Jie, Vice President of Nanjing Hitech Composites visited NEXCEL. Both sides had discussions on the applications and challenges of large pultruded FRP profile in construction and building area.

NEXCEL visited CNBM ZHONGYAN Tech.
May 25, 2024

On May 25, 2024, NEXCEL team visited CNBM Zhongyan Technology to discuss the development progress of 2022 TDA Project 'Research and Application of Novel Polyether macromonomer and Ultra-highly Dispersing Polycarboxylate Superplasticizer'. Both parties exchanged views on the future application and promotion of the polycarboxylate superplasticizer.

Southwest University of Science and Technology visited NEXCEL
MAY 29, 2024

On May 29, 2024, Prof. Gu Tao from Southwest University of Science and Technology visited NEXCEL, and both sides had exchanges on potential applications of polymers in oil well cement.

NEXCEL visits Yangtze River Delta Carbon Fiber & Composite Innovation Center
OCT 15, 2024

NEXCEL team visited the Yangtze River Delta Carbon Fiber & Composite Innovation Center (CCIC). Prof. Yi Xiaosu, Executive Director, and Prof. Zhao Wenming, Deputy Director of CCIC, attended the meeting. During the meeting, both parties initially agreed to carry out in-depth cooperation in research and development, project promotion, industry training, technical forums and other areas. This is a contribution for NEXCEL to strengthen relationships and further collaboration with other innovation centers.

NEXCEL visits National and Local joint Engineering Research Center for Basalt Fiber Production and Application
OCT 16, 2024

NEXCEL visited the National and Local Joint Engineering Research Center for Basalt Fiber Production and Application Technology. Prof Wang Xin, Deputy Director of Basalt Center attended the meeting. During the meeting, both parties will carry out in-depth cooperation in research and development, advocacy and training, technical forums and other areas in the future.

Prof. LI Zongjin from Macao University of Science and Technology visited NEXCEL and was appointed as Strategic Consultant
NOV 25, 2024

Prof. LI Zongjin, an internationally renowned scholar from Macao University of Science and Technology, was appointed as NEXCEL Strategic Consultant. As a Fellow of ACI and Founding President of the ACI China Chapter, Prof. LI has received the Arthur R. Anderson Medal. He is well known within the cement-based materials and nano materials sector and serves as a member of ISO technical committee ISO/TC 71. On behalf of NEXCEL, Dr. LI Juan presented a letter of appointment to Prof. LI Zongjin and discussed advanced cement-based materials, FRP - seawater sea-sand concrete, nano materials, aerogel materials, in-situ polymerization technology of polymers in cement matrix.



Publication

No.	Project No.	Paper
1	22TDA1-1	*Analysis-oriented model for FRP tube-confined concrete: 3D interpretation of biaxial tube behaviour*
2		*Strengthening RC beams with mid-span supporting prestressed CFRP plates: An experimental investigation*
3		*Application of ultra-lightweight and large-scale pultruded for external frame beam in high-rise buildings (in Chinese)*
4		*A binary resin system of epoxy and phenol-formaldehyde for improving the thermo-mechanical behavior of FRP composites*
5		*Non-linear behaviors of pultruded GFRP composites*
6		*Flexural performance of curved-pultruded GFRP arch beams subjected to varying boundary conditions*
7	22TDA2-4	*Rheological properties of warm mixed asphalt*
8		*Effect of warm mix agent on the chemo-mechanical performance of binder with different oil sources*
9	22TDA3-1	*Preparation and performance of EPEG-type PCE and its application in ultra-high performance concrete*
10		*Research status and prospect of domestic polyether macromonomer (in Chinese)*
11		*Research on the mix proportion of low-carbon concrete utilizing a novel polycarboxylate Superplasticizer*
12		*Research on the effect and mechanism of binder-sand ratio on UHPC performance*
13	22TDA4-1	*Comparative study of standard stroke load design of communication poles and towers in China, America and Europe (in Chinese)*
14		*Improving performance of GFRP joints using bolted/mortise-tenon hybrid method*
15	22SFP1-1	*Differences in micro grain/fiber distributions between matrix and interlayer of cementitious filaments affected by extrusion molding*
16		*Gradient distribution of slender glass microfibers in 3D printed cementitious filaments*
17		*Rebar-matrix interface in extrusion molded cementitious filaments*
18	22SFP2-1	*Research on properties of sulfoaluminate cement-based premixed fluid solidified soil curing agent (in Chinese)*
19		*Fluid solidification of construction waste soil (in Chinese)*

No.	Project No.	Paper
20	22SFP3-1	*Performance research and engineering application of in-place recycled asphalt mixture with warm mixing technology (in Chinese)*
21	22SFP4-1	*Influence of slurry characteristics on the bubble stability in foamed concrete*
22		*Process optimization study of encapsulation method for pretreatment of recycled EPS particles (in Chinese)*
23	22SFP5-1	*Effects of polymer-cement ratio on the properties of polymer mortar (in Chinese)*
24		*Effect of polymer modified volcanic rock coarse aggregate on properties of concrete (in Chinese)*
25	22PHD-1	*Mixed-alkali effect on thermal property and elastic behavior in borosilicate glasses*
26	22PHD-2	*Impacts of asphalt and mineral types on interfacial behaviors: A molecular dynamics study*
27		*Interfacial performance of asphalt-aggregate system under different conditions based on molecular dynamics simulation*
28		*Comprehensive evaluation of ballastless-track sealants based on macro–micro tests and principal component analysis*
29	23TDA1-1	*Improving the interfacial properties of PVA fiber and cementitious composite: Design and characterization*
30		*A Two-Step Synthesis of Porous Nitrogen-Doped Graphene for Electrochemical Capacitors*
31		*Impact of C-F-S-H/PCE Nanocomposites on Hydration and Mechanical Properties of Slag Cement (in Chinese)*
32	23TDA2-2	*Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*
33		*Exploring the structure, characteristics, and thermal degradation of composites comprising thermoplastic polyolefin and graphene oxide under high-temperature dynamic shear conditions*
34	23TDA3-2	*Experimental study on seismic performance of two-story two-bay. Precast concrete frame with UHPC-based connections*
35		*Out-of-plane response of prefabricated concrete shear walls connected via grouted sleeves*

No.	Project No.	Paper
36	23TDA4-1	*Strength retention rate distribution model and reliability analysis of FRP stirrups (in Chinese)*
37		*Shear behavior of two-span continuous concrete deep beams reinforced with GFRP bars*
38		*Calculation method of the flexural tensile strength of the GFRP stirrups based on the database (in Chinese)*
39		*Transfer learning-based confinement strength prediction of concrete confined by FRP transverse reinforcements*
40		*Flexural Behavior and Design of Ultrahigh-Performance Concrete Beams Reinforced with GFRP Bars*
41		*Experimental Investigation on Pure Torsion Behavior of Concrete Beams Reinforced with Glass Fiber-Reinforced Polymer Bars*
42		*A modified softened truss model and strength prediction formula for fiber-reinforced polymer reinforced concrete members under pure torsion*
43	23TDA6-2	*Effect of styrene acrylic latex on the performance of metakaolin blended cement: From hydration to mechanical properties*
44	23SFP1-2	*Microscopic properties of asphalt and polyethylene at an extraordinary high dosage through molecular dynamics simulation*
45		*Preparation method and properties of high viscosity and elasticity road asphalt modified with recycled low-density polyethylene plastic at a large dosage (in Chinese)*
46	23SFP4-1	*Protective and flame retardant bifunctional epoxy-based-nanocomposite coating by intercomponent Synergy between Modified CaAl-LDH and rGO*
47		*Preparation of tung oil microcapsules and their self-healing properties (in Chinese)*
48		*Preparation of graphene oxide/aluminum hypophosphite hybrids and the improvement on flame retardancy in PC/ABS (in Chinese)*
49	23PHD-1	*Novel bamboo-raft-type floating structure (BRT-FS) assembled by FRP reinforced concrete tubes: Conceptual design and analysis*
50		*Mesoscale simulation method for preplaced aggregate concrete based on physics engine*

No.	Project No.	Paper
51	23PHD-6	*Modification of early-age microstructure and enhanced mechanical properties of cement paste via injecting low-dose CO2 at fresh stage*
52		*Effect of CO2-mixing dose and prolonged mixing time on fresh and hardened properties of cement pastes*
53	23PHD-8	*Experimental investigation on transverse tension-tension fatigue behavior of pultruded GFRP unidirectional lamina*
54		*Prediction of fatigue crack propagation in center cracked steel plate strengthened with partially covered CFRP strip*
55		*Probabilistic fatigue stiffness variation of angle-ply GFRP composites considering stress ratio effect*
56	24SFP-4	*Design, preparation and mechanical properties of novel glass fiber reinforced polypropylene bending bars*
57		*Long-term properties evolution and life prediction of glass fiber reinforced thermoplastic bending bars exposed in concrete alkaline environment*
58	24PHD-1	*Optimization design of asphalt emulsion with rejuvenator towards a uniform distribution inside the damaged porous asphalt mixture for a better ravelling resistance*
59	24PHD-4	*Multifunctional phosphorus-containing imidazoliums endowing one-component epoxy resins with superior thermal latency, heat resistance, mechanical properties, and fire safety*
60		*Development of single-component epoxy resin with superb thermal stability, flame retardancy, smoke suppression, and latency via Cu-based phosphorus/imidazole-containing complex*
61	24PHD-5	*A pull-out equivalent telescopic layered failure model of carbon fiber bundles in seawater sea-sand cementitious matrix*
62		*Effect of ICCP on tensile performance and piezores effect of CFRCM plates*
63		*Effect of ICCP on bond performance and piezoresistive effect of carbon fiber bundles in cementitious matrix*
64		*Effect of ICCP on tensile performance of carbon fiber bundles in seawater sea-sand cementitious matrix*

Patent

No.	Project No.	Stutes	Patent No.	Patent Name
1	22TDA1-1	Filed		A fire- and flame-retardant pultruded fiber reinforced composite and its manufacturing method
2		Granted	ZL202320009061.9	A fire-retardant pultruded fiber reinforced composite profile
3		Filed		An anchoring device for clamping carbon plates and its method of use
4		Granted	ZL202421047061.9	An anchoring device for clamping carbon plates
5		Granted	ZL202421061732.7	A carbon fiber composite plate stay cable
6		Filed		A carbon fiber composite plate stay cable
7		Filed		A strengthening device and strengthening method
8		Filed		A strengthening device
9	22TDA2-4	Filed		Activator for in-place foamed warm regeneration mixture, foamed warm regeneration mixture and its preparation method
10	22TDA3-1	Filed		An ultra-high dispersed water reducer and its preparation method
11		Filed		An ultra-high dispersed water reducer and its preparation method
12		Granted	ZL202310596973.5	A hyperbranched polyether and its preparation method
13		Granted	ZL202310596949.1	An ultra-highly dispersing polycarboxylate superplasticizer and its preparation method
14	22TDA4-1	Filed		A washboard corner composite profile, forming tooling and preparation method, application
15	22SFP1-1	Filed		Micro vibration method and 3D printing of concrete components
16		Filed		Preparation method and application of polymer emulsion
17	22SFP2-1	Granted	ZL202310753459.8	A special dispersant for soil stabilizing admixture and its preparation method and application
18		Granted	ZL202310260905.1	Anti-washout stabilizing admixtures for Solidification of underwater sludge and its preparation method and application
19	22SFP3-1	Filed		A kind of hot-in-place recycled asphalt mixture with warm-mixed technology and its preparation method
20	22SFP4-1	Filed		The invention relates to a pretreatment method for EPS particles and a preparation method for EPS particles foamed concrete

No.	Project No.	Stutes	Patent No.	Patent Name
21	22SFP5-1	Granted	ZL202223501265.9	One mixing and filtering machine for polymer mortar modified coarse aggregate
22	23TDA1-1	Filed		Conductive cementitious materials based on modified aggregate coated graphene and their preparation method
23	23TDA2-2	Filed		A TPO composite waterproof membrane
24		Filed		A waterproof roll material
25	23TDA3-2	Filed		A thermal insulation wall connector
26	23TDA4-1	Filed		A device and process for producing FRP stirrups
27	23TDA5-1	Filed		Modification of vinyl ester resin and preparation method thereof
28	23TDA6-2	Filed		A device and construction method for concrete pavement based on an imposed magnetic field
29	23SFP1-2	Granted	ZL20232097178.4	A type of miscible storage device for waste plastic modified asphalt
30		Granted	ZL20232097182.0	A device for preparing waste plastic modified asphalt
31	23SFP4-1	Filed		Preparation method and application of flame-retardant and self-healing epoxy-based or polyurethane-based composite coatings
32	23PHD-1	Filed		Raft-type Platform with Photovoltaic and Wave Power Generation System
33	24TDA-1	Filed		A highly stable concrete in low vacuum tube environments and its preparation method
34	24TDA-2	Filed		A low-cost hydrophobic phenolic resin-based aerogel fiber composite material and its preparation method and application
35	24TDA-4	Filed		A method for evaluating the degree of curing of polyurethane mixes for road use
36	24SFP-4	Filed		New bending device for fiber reinforced thermoplastic composite stirrups
37		Filed		Bending forming device for thermoplastic fiber reinforced composite stirrups and manufacturing method
38		Filed		New bending device and forming method for fiber reinforced thermoplastic composite stirrups
39	24SFP-5	Filed		Hydrocarbon-based graphene modified asphalt and its preparation method

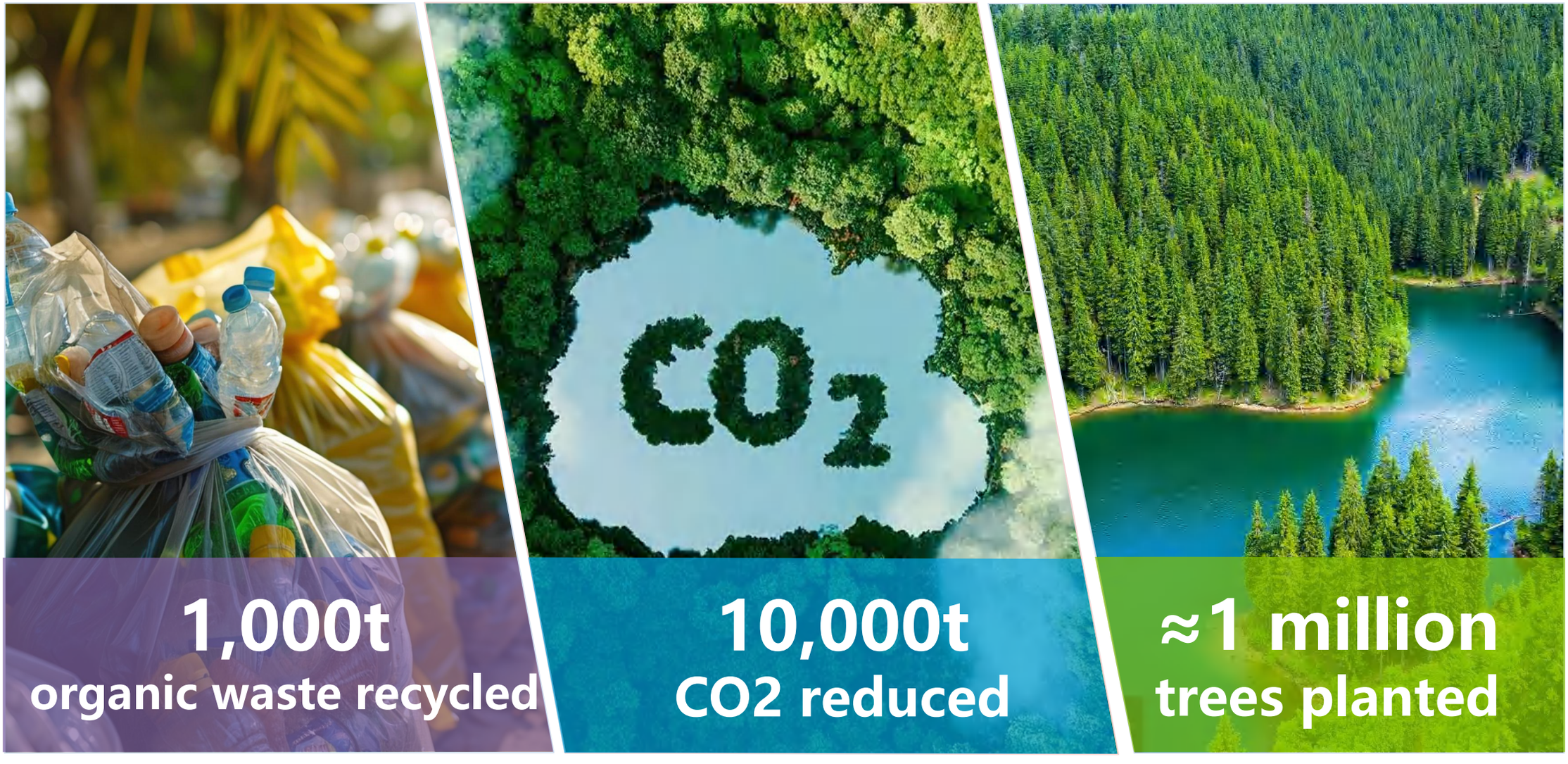
No.	Project No.	Stutes	Standard Name
1	22TDA1-1	Issued （T/CSTM 01345-2024)	Code of technical practice for FRP composite cooling tower structures
2	22TDA2-4	Draft for Review	Technical specification for mechanically foamed warm mix asphalt
3	22TDA4-1	Draft for Review	Specification for the manufacture of composite lattice towers for communication
4	22SFP1-1	Draft for approval	Test method for interfacial bonding strength of 3D-printed cement-based materials
5	22SFP3-1	Issued （T/CHTS 10137-2024)	Technical guide for hot in-place recycling clean construction of asphalt pavement
6	23TDA2-2	Issued （T/CECS 10374-2024)	Pre-applied butyl polymer waterproofing membrane
7	23SFP1-2	Draft for Review	Technical specification for application of recycled plastic filler for asphalt mixture
8	23SFP2-1	Draft for Review	Thermoplastic fiber-reinforced polymer composite bar
9	23SFP3-2	Draft for Review	Recycled plastics for building plastic formwork
10	23SFP4-1	Issued （T/CSCP 0003-2023)	Self-healing performance evaluation methods of organic coating

APPENDIX

Demonstration

No.	Project No.	Focused Area	Time for Completion	Name
1	22TDA1-1	FRPs	2023	Pultruded GFRP External Frame Beam for High-rise Building in Qingdao
2	22TDA2-4	Pavement for road & bridges	2023	Foam Warm Mix Asphalt Technology Successfully Applied in Anhui Wuyue Expressway
3			2023	Mechanical Foaming Warm Mix Asphalt Pavement in Xin Jiang G216 Expressway
4	22TDA3-1	Construction chemicals	2023	Pilot Production of Novel Polyether Macromonomer
5			2023	Ultra-highly Dispersing PCE for UHPC Applied to Moshuihe Bridge in Shandong
6			2024	Ultra-highly Dispersing PCE for UHPC Applied to Xiaoqinghe Grand Bridge in Shandong
7			2024	Ultra-highly Dispersing PCE Applied to the Underground Pipelines in Dezhou, Shandong
8	22TDA4-1	FRPs	2023	FRP Composite Lattice Tower Built in Egypt
9			2024	FRP Composite Lattice Tower Built in Guangdong
10	22SFP1-1	Special mortars & concrete	2023	3D Printing Polymer Modified Concrete for Landscape Water Wall
11	22SFP2-1	Construction chemicals	2023	Admixtures for Solidified Soil Applied to Fabricated Building
12	22SFP3-1	Pavement for road & bridges	2023	In-place Recycling of Waste Asphalt Pavement in Baotou-Maoming Expressway
13			2023	In-place Recycling of Waste Asphalt Pavement in Shanghai-Shaanxi Expressway

No.	Project No.	Focused Area	Time for Completion	Name
14	22SFP4-1	Insulation & composite cladding	2023	Recycled EPS/foamed Concrete in Composite Sandwich Panel Applied to Fabricated Buildings
15	22SFP5-1	Special mortars & concrete	2023	Polymer Modified Inferior Coarse Aggregate Applied to Concrete Sleepers
16	23TDA2-2	Waterproofing & repair materials	2024	TPO Waterproofing Membrane in Western (Chongqing) Science City
17	23TDA3-2	Insulation & composite cladding	2024	PIR Insulation Material Applied to Ultra-low Energy Buildings in Beijing
18	23TDA5-1	FRPs	2024	FRP Rebars Applied to Lach Huyen Port in Vietnam
19	23TDA6-2	Special mortars & concrete	2024	Gradient Reinforced Polymer Modified Concrete Applied to Shanghai Outer Ring Road
20	23SFP1-2	Pavement for road & bridges	2024	Asphalt Mixtures Incorporating Large Amount of Recycled Plastics Applied to the Road Reconstruction Project
21	23SFP3-2	Construction chemicals	2024	Waste Plastics Applied to Building Formwork in Xuchang, Henan
22	24SFP-3	Pavement for road & bridges	2024	A Production Line of Phase Change Energy Storage Composite Particles for Asphalt Pavement



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