同行专家业内评价意见书编号：20250858264

附件1

浙江工程师学院（浙江大学工程师学院）
同行专家业内评价意见书

姓名：夏若曦

学号：22260144

申报工程师职称专业类别（领域）：能源动力

浙江工程师学院（浙江大学工程师学院）制

2025年05月23日

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一、个人申报

（一）基本情况【围绕《浙江工程师学院（浙江大学工程师学院）工程类专业学位研究生工程师职称评审参考指标》，结合该专业类别(领域)工程师职称评审相关标准，举例说明】

1.对本专业基础理论知识和专业技术知识掌握情况(不少于200字)

1、掌握了工程经济学、材料性能及测试、氢气渗透等方面的知识：通过参与非金属管道材料（如HDPE管、PSP管及PA管）的力学性能测试，我深入了解了材料科学中的应力应变分析、材料失效模式及其在高压氢气和海洋环境下的行为；通过构建氢气渗透分析模型和进行氢气渗透性试验，我掌握了氢气在不同材料中的溶解度系数、扩散系数及渗透系数的计算和应用。这些理论知识帮助我理解氢气在非金属管道基体与增强体材料中的溶解和扩散规律。
2、在专业实践的过程中，我参与实验数据的收集、整理和分析，掌握了如何利用实验数据建立理论模型并进行验证。这些技能对科研工作中的数据处理和结果分析非常关键。同时通过参与项目的申报、实施和管理工作，我提升了对科研项目的整体规划和协调能力，学会了如何制定项目计划、分配任务和监控项目进度。在成功授权了一项国家发明专利的过程中，提升了我的科研写作能力和专利申请技巧。这些能力对今后的科研工作具有重要意义。
3、项目的专业实践培养了我严谨求实，与团队协调配合的能力，在参与各种实验和数据分析工作时，我学会了如何保持严谨的科学态度，注重实验数据的准确性和可靠性。同时作为项目的一份子，我承担了具体任务并确保其按时高质量完成，培养了强烈的责任感和使命感以及在面对项目的各种挑战和压力时，我学会了如何保持冷静和积极应对，提升了自己的抗压能力和解决问题的能力。

2.工程实践的经历(不少于200字)

1、在管道建设成本估算上，我负责形成基于材料性能、工艺优化及结构改进的海洋非金属输氢管道设计方案，并为管道建设成本的估算提供依据。通过这一工作，企业能够更准确地进行项目预算和成本控制，提高资金使用效率，降低项目风险。
2、通过参与非金属管材氢相容性测试装备的研制工作，我学习并应用了先进的技术，解决了高压氢环境下非金属管材可靠密封的技术难题。该装备能够在实际使用条件下进行原位测试，有效提高了测试的准确性和可靠性。这一创新不仅提升了企业在高压氢环境材料测试领域的技术水平，还填补了国内在该领域的技术空白，促进了相关产业的发展。
3、参与了氢气渗透性试验，并基于实验数据建立了氢气渗透理论计算模型。通过这一创新性工作，明确了不同环境条件下非金属管材的氢气溶解和扩散规律，为企业在非金属输氢管道材料的选择和改进方面提供了科学依据。这一技术的应用，有效提高了管道材料的使用寿命和安全性，减少了因材料失效导致的经济损失和安全隐患。
4、通过研究材料改性方法和管材加工方式，协助研制出了氢相容性良好的新型海洋非金属输氢管材。该新型管材具有更好的耐压性能和氢渗漏性能，能够在高压氢环境和海洋服役环境中保持稳定性和可靠性。这一成果的应用，有助于提高海洋非金属输氢管道的整体性能，降低维护和更换成本，从而为企业带来显著的经济效益。

3.在实际工作中综合运用所学知识解决复杂工程问题的案例（不少于1000字）

项目背景与复杂问题界定
随着我国海洋可再生能源开发战略的推进，氢能作为清洁能源载体在海上风电制氢、海底储氢等场景的应用需求激增。然而，传统金属输氢管道存在重量大、耐腐蚀性差、成本高等问题，非金属管道（如高密度聚乙烯HDPE、尼龙PA等）因其轻量化、抗腐蚀等优势成为替代方案。但海洋环境叠加高压氢工况对非金属管道提出了严苛要求：
高压氢渗透，氢气分子易渗入非金属材料基体，导致材料力学性能退化；

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动态密封失效：管材在高压（4-10 MPa）下易发生蠕变松弛，造成密封界面泄漏；
原位测试缺失：缺乏可模拟海洋环境（温度、压力、流速）的氢相容性测试装备，导致实验室数据与工程实际偏差显著。
为此，本研究依托“海洋非金属输氢管道材料氢相容性测试评价方法及装备研制”项目（经费350万元），重点攻克非金属管材在高压氢环境下的渗透性控制、结构优化及成本效益平衡难题，构建从材料性能测试到工程应用的完整技术体系。
复杂问题解析与技术挑战
（一）关键问题识别
复合管多层级氢渗透机制不明：需探明氢气在非金属复合管不同结构层（内层、增强层、外层）及其界面上的浓度梯度与压力分布规律，揭示氢分子在材料空穴、微孔洞中的扩散动力学（如Fick扩散系数）与解吸行为。
多因素耦合损伤机理复杂：海洋环境中海水腐蚀、动态洋流载荷与高压氢的协同作用会加速非金属管材损伤，影响管道预期寿命。
（二）核心技术挑战
复合管层间氢渗透原位表征：需突破非金属复合管多层材料氢分布的同步监测难题，开发可区分内层、增强层及界面氢浓度的微区探测技术，解决氢在纳米级微孔洞中扩散路径的可视化问题。
极端环境密封与测量可靠性：海洋高压氢环境下，非金属管材因蠕变导致密封面泄漏率超标，需设计自适应性密封结构。
综合解决方案设计与实施
本研究聚焦于海洋非金属输氢管道材料氢相容性测试评价方法与装备研制，重点攻克非金属管材在高压氢环境下的渗透性控制、结构优化及成本效益分析等核心问题。本人承担的具体工作为形成基于材料性能、工艺优化及结构改进的海洋非金属输氢管道设计方案。根据氢能输送需求与设备承压能力；设定设计压力上限为4MPa，流速上限为20m/s，输送量为500kg/d~50t/d，进行管道输氢系统成本构成研究：分析管道建设成本，包括材料费用、铺设费用，考虑不同材质（如碳钢、HDPE等）管道成本差异；研究运行成本，涵盖能源消耗（如动力能源用于维持氢气输送压力等）、维护保养费用（定期检测、维修等费用）、人工成本等方面，全面梳理输氢系统综合成本的各项组成部分。不同类型输氢管道技术分析：对不同压力等级的输氢管道进行技术剖析，研究高压、中压、低压输氢管道在输送能力、适用场景、安全要求等方面的差异；分析不同管径输氢管道的流动特性、压力损失等技术指标，了解其对氢气输送效率的影响。结合成本与技术的选型研究：根据综合成本分析结果和不同类型输氢管道技术特点，建立选型模型，考虑项目的具体需求（如输送规模、输送距离等），确定在不同条件下最优的输氢管道类型、规格及敷设方式。制定针对不同应用场景的选型策略，如对于长距离大规模输氢、短距离小流量输氢等情况分别给出适宜的选型方案。同时明确氢气在非金属管道中的渗透性参数，包括溶解度系数（S）、扩散系数（D）、渗透系数（P），建立氢气渗透理论计算模型。目前的工艺方案计算及氢渗透量计算任务已完成，同时成功授权一项国家发明专利《一种海洋悬浮式氢电联送系统》，发表两篇EI会议论文《A REVIEW ON HYDROGEN PRODUCTION FROM OCEAN RENEWABLE ENERGY AND THE APPLICATION STATUS》、《INVESTIGATION ON CARBON EMISSION REDUCTION OF NON-METALLIC COMPOSITE PIPELINE FOR HYDROGEN TRANSPORTATION》。
经验总结与启示
学科交叉的必要性：解决复杂工程问题需融合材料、力学、流体等多学科知识，单一技术路线难以突破系统瓶颈；
迭代优化思维：从实验室小试到工程验证需经历“设计-测试-反馈-改进”的螺旋式上升过程；
标准化驱动创新：技术标准的制定不仅是成果固化手段，更是推动行业技术进步的关键杠杆

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。
该案例深刻体现了理论知识与工程实践的深度融合，印证了“从实验室到工程现场”的技术转化逻辑，为氢能基础设施安全建设提供了可复用的方法论。

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（二）取得的业绩（代表作）【限填3项，须提交证明原件（包括发表的论文、出版的著作、专利证书、获奖证书、科技项目立项文件或合同、企业证明等）供核实，并提供复印件一份】

1.
公开成果代表作【论文发表、专利成果、软件著作权、标准规范与行业工法制定、著作编写、科技成果获奖、学位论文等】

成果名称	成果类别 [含论文、授权专利（含发明专利申请）、软件著作权、标准、工法、著作、获奖、学位论文等]	发表时间/授权或申请时间等	刊物名称/专利授权或申请号等	本人排名/总人数	备注
A REVIEW ON HYDROGEN PRODUCTION FROM OCEAN RENEWABLE ENERGY AND THE APPLICATION STATUS	会议论文	2023年11月29日	ASME 2023 Pressure Vessels & Piping Conference	2/5	EI会议收录
INVESTIGATION ON CARBON EMISSION REDUCTION OF NON-METALLIC COMPOSITE PIPELINE FOR HYDROGEN TRANSPORTATION	会议论文	2024年11月14日	ASME 2024 Pressure Vessels & Piping Conference	2/6	EI会议收录
一种海洋悬浮式氢电联送系统	授权发明专利	2022年12月16日	专利号：ZL 202211617811.7	2/5	

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2.其他代表作【主持或参与的课题研究项目、科技成果应用转化推广、企业技术难题解决方案、自主研发设计的产品或样机、技术报告、设计图纸、软课题研究报告、可行性研究报告、规划设计方案、施工或调试报告、工程实验、技术培训教材、推动行业发展中发挥的作用及取得的经济社会效益等】

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（三）在校期间课程、专业实践训练及学位论文相关情况	
课程成绩情况	按课程学分核算的平均成绩： 88 分
专业实践训练时间及考核情况(具有三年及以上工作经历的不作要求)	累计时间： 1.1 年（要求1年及以上） 考核成绩： 87 分
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22260144

二、日常表现考核评价及申报材料审核公示结果

日常表现考核评价	非定向生由德育导师考核评价、定向生由所在工作单位考核评价： ☑优秀　□良好　□合格　□不合格 德育导师/定向生所在工作单位分管领导签字（公章）：周永智　2025年5月23日
申报材料审核公示	根据评审条件，工程师学院已对申报人员进行材料审核（学位课程成绩、专业实践训练时间及考核、学位论文、代表作等情况），并将符合要求的申报材料在学院网站公示不少于5个工作日，具体公示结果如下： □通过　□不通过（具体原因：　　　　　　） 工程师学院教学管理办公室审核签字（公章）：　　年　月　日

浙 江 大 学 研 究 生 院

攻读硕士学位研究生成绩表

学号：22260144	姓名：夏若曦	性别：女	学院：工程师学院	专业：能源动力
学制：2.5年				
毕业时最低应获：24.0学分	已获得：27.0学分	入学年月：2022-09	毕业年月：	
学位证书号：	毕业证书号：	授予学位：		

学习时间	课程名称	备注	学分	成绩	课程性质	学习时间	课程名称	备注	学分	成绩	课程性质
2022-2023学年秋季学期	工程技术创新前沿		1.5	90	专业学位课	2022-2023学年冬季学期	产业技术发展前沿		1.5	80	专业学位课
2022-2023学年秋季学期	新能源发电与变流技术		2.0	92	专业学位课	2022-2023学年春季学期	自然辩证法概论		1.0	86	公共学位课
2022-2023学年冬季学期	低碳能源系统理论与设计		2.0	93	专业选修课	2022-2023学年夏季学期	研究生英语基础技能		1.0	免修	公共学位课
2022-2023学年秋冬学期	工程伦理		2.0	86	公共学位课	2022-2023学年夏季学期	研究生论文写作指导		1.0	92	专业学位课
2022-2023学年冬季学期	综合能源系统集成优化		2.0	91	专业学位课	2022-2023学年春夏学期	高阶工程认知实践		3.0	90	专业学位课
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2022-2023学年秋冬学期	科技创新案例探讨与实战		2.0	86	专业选修课		硕士生读书报告		2.0	通过	
2022-2023学年冬季学期	新时代中国特色社会主义理论与实践		2.0	93	公共学位课						

说明：1. 研究生课程按三种方法计分：百分制，两级制（通过、不通过），五级制（优、良、中、及格、不及格）。

2. 备注中“*”表示重修课程。

学院成绩校核章：

成绩校核人：张梦依

打印日期：2025-06-03

浙江大学研究生院 (60) 成绩校核章

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PROCEEDINGS PAPER

A Review on Hydrogen Production From Ocean Renewable Energy and the Application Status

Jianfeng Shi, Ruoxi Xia, Xingyu Zheng, Riwu Yao, Jinyang Zheng

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Abstract

Ocean renewable energy development is strategically significant to the world's low-carbon energy transformation. Many ocean renewable energy development projects have been carried out or are under planning. Combining green hydrogen and ocean renewable energy is ideal for developing ocean renewable energy. This paper first surveyed the main ocean renewable energy hydrogen production projects worldwide. Detailed information about these projects' technical routes and the scale of renewable energy development were then summarized. With ocean renewable energy development gradually moving towards greater offshore distance and water depth, large-scale and low-cost ocean renewable energy development has become a critical concern in industry and academia. Therefore, a comparison about the energy transmission mode is then carried out. Furthermore, based on the current ocean renewable energy development projects, the development trend of hydrogen production from ocean renewable energy was analyzed, including increased offshore distance and water depth, development of floating wind platforms, and large-scale wind turbines. Meanwhile, the main technical challenges are discussed in detail to achieve large-scale and low-cost ocean renewable energy development.

Volume Subject Area: Fluid-Structure Interaction
Keywords: hydrogen production, ocean renewable energy, technical route, development trends, technical challenges
Topics: Hydrogen production, Ocean energy

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A REVIEW ON HYDROGEN PRODUCTION FROM OCEAN RENEWABLE ENERGY AND THE APPLICATION STATUS

Jianfeng Shi [1, 2, 3], **Ruoxi Xia** [1], **Xinyu Zheng**[1], **Riwu Yao** [4*], **Jinyang Zheng** [1, 2, 5]

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ABSTRACT

Ocean renewable energy development is strategically significant to the world's low-carbon energy transformation. Many ocean renewable energy development projects have been carried out or are under planning. Combining green hydrogen and ocean renewable energy is ideal for developing ocean renewable energy. This paper first surveyed the main ocean renewable energy hydrogen production projects worldwide. Detailed information about these projects' technical routes and the scale of renewable energy development were then summarized. With ocean renewable energy development gradually moving towards greater offshore distance and water depth, large-scale and low-cost ocean renewable energy development has become a critical concern in industry and academia. Therefore, a comparison about the energy transmission mode is then carried out. Furthermore, based on the current ocean renewable energy development projects, the development trend of hydrogen production from ocean renewable energy was analyzed, including increased offshore distance and water depth, development of floating wind platforms, and large-scale wind turbines. Meanwhile, the main technical challenges are discussed in detail to achieve large-scale and low-cost ocean renewable energy development.

Keywords: Hydrogen production, Ocean renewable energy, Technical route, Development trends, Technical challenges

1. BACKGROUND

Under the influence of the surge in world energy demand, ocean renewable energy has sparked wide interest [1]. Ocean renewable energy mainly includes offshore wind, offshore photovoltaic, and wave energy [2]. From the current situation, the offshore wind power industry has the most significant scale [3]. The cumulative installed capacity of offshore wind power has increased from 3.8 GW in 2011 to 54 GW in 2021 [4]. In contrast, wave energy and tidal current energy projects

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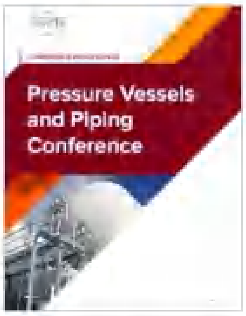

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Investigation on Carbon Emission Reduction of Non-Metallic Composite Pipeline for Hydrogen Transportation

Jianfeng Shi, Ruoxi Xia, Jinyang Zheng, Zhongzhen Wang, Xinyu Zheng, Riwu Yau

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Abstract

Non-metallic composite pipelines possess remarkable flexibility and exceptional resistance to corrosion. Compared to traditional metallic hydrogen pipelines, non-metallic composite hydrogen pipelines effectively mitigate the challenges of hydrogen corrosion and brittleness, positioning them as a promising alternative for large-scale, low-cost hydrogen transportation. Moreover, compared to traditional metal pipelines, non-metallic composite hydrogen pipelines exhibit lower wall roughness, effectively reducing hydraulic losses and offering carbon reduction advantages. Within the lifecycle of non-metallic composite pipelines, carbon emissions during the operational stage predominate. Consequently, this study proposes a method for calculating carbon emissions associated with the operational stage of non-metallic composite hydrogen pipelines. This method involves calculating the pipeline's friction coefficient, followed by hydraulic loss calculations, and then analyzing carbon emissions based on the electricity consumption of the hydrogen pumps. The results obtained from this method were compared with standards, and a good agreement was demonstrated, confirming the method's reliability. Subsequently, comparisons with metal pipelines revealed that utilizing non-metallic composite pipelines can effectively reduce carbon emissions. Additionally, the influence of pipeline diameter, hydrogen pressure, and flow velocity on friction losses and carbon emissions were analyzed in detail. The results of this study can guide the design of structural and operational parameters of non-metallic hydrogen pipelines, better leveraging the advantages of non-metallic composite pipelines in hydrogen transportation.

Volume Subject Area: Design & Analysis
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INVESTIGATION ON CARBON EMISSION REDUCTION OF NON-METALLIC COMPOSITE PIPELINE FOR HYDROGEN TRANSPORTATION

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ABSTRACT

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Keywords: Non-metallic composite pipelines, Hydrogen pipelines, Hydraulic calculations, carbon emissions calculations

NOMENCLATURE

R	Ideal gas constant, R = 8.314 J/(mol·K)
M	Molar mass of hydrogen, M = 2.016 g/mol
Re	Reynolds number
D	Outer diameter of the pipe, mm
d	Inner diameter of the pipe, mm
μ	Gas viscosity, Pa·s
δ	Thickness of the viscous sublayer, mm

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