

Digital Twin for integrated production and maintenance planning in hydrogen-based process industries

Introduction

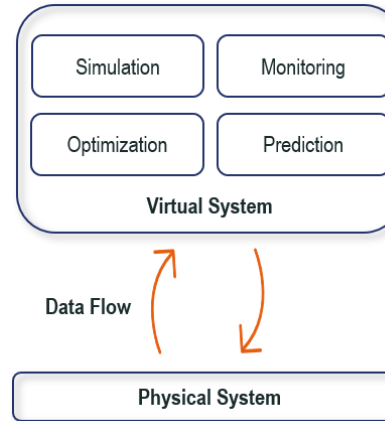
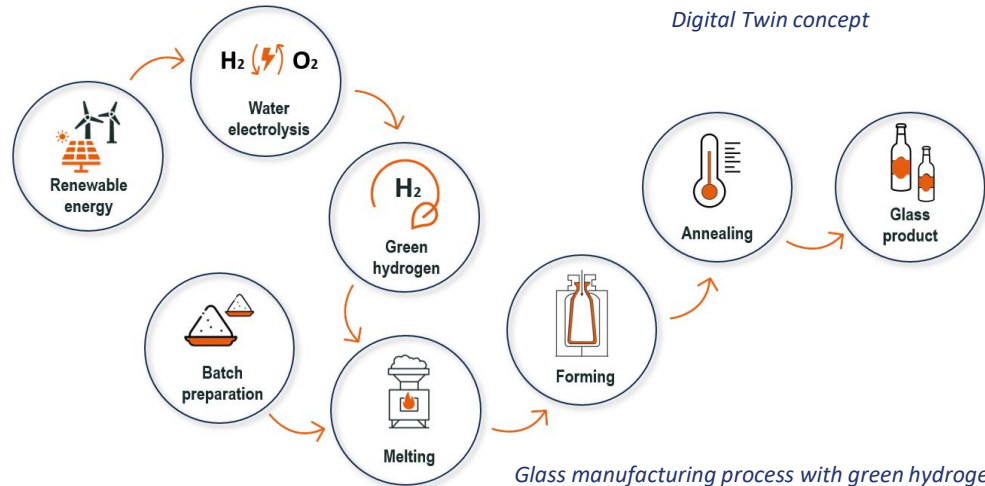
Green hydrogen offers a promising path to decarbonize energy-intensive process industries like glass, aluminium, and steel. H2GLASS, the EU initiative funding this research, is moving in this direction. The goal is to demonstrate the feasibility of integrating green hydrogen into glass production and prove its transferability to the aluminium sector. However, this transition may bring several challenges due to different combustion conditions, potentially affecting glass quality and furnace integrity. To remain competitive, process industries rely on maximizing production efficiency, leveraging effective maintenance to minimize costly downtime and ensure continuous production. Maintenance becomes even more critical when a hazardous substance is introduced in the process. To address the expected inefficiencies glass manufacturers may face, Digital Twin (DT) has been identified as relevant for optimizing production and managing maintenance. Furthermore, considering the interdependencies between these tasks, adopting an integrated perspective on their related decision-making processes can enhance overall business performance, as claimed by many researchers.

Primary objective

Investigate the benefits of integrating production and maintenance planning using DT in hydrogen-based process industries

Secondary objectives

- Develop a decision support tool to assess the potential benefits of DT implementation based on manufacturing process characteristics
- Investigate the implications of integrating hydrogen into glass manufacturing from production and maintenance perspectives
- Develop a DT-based framework for the joint planning of production and maintenance in hydrogen-based process industries



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Related projects: H2GLASS - advancing Hydrogen (H₂) technologies and smart production systems TO decarbonise the GLass and Aluminium Sectors

- PhD candidate at the Department of Mechanical and Industrial Engineering (NTNU)
- MSc in Management Engineering – Analytics for Business at Politecnico of Milano (2021-2023)
- BSc in Management Engineering at Politecnico of Milano (2018-2021)



Estimated progress of the PhD project:



Publications

- G. Fede, F. Sgarbossa, N. Paltrinieri (2024). Integrating production and maintenance decisions in process industries using Digital Twin: A literature review. 18th IFAC Symposium on Information Control Problems in Manufacturing – INCOM2024 (**submitted**)