

Sustainable Materialization of Residues from Thermal Processes into Products

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Aim of the project

Sustainable use of solid residues and carbon dioxide, the two largest and most important waste products from thermal processes, is an urgent issue both for the industry involved and society as a whole, considering the financial and environmental repercussions of their production. This Knowledge Platform focuses on three types of waste-to-product valorisation: production of a carbon sink, construction materials, or sorbents.

Thermal processes are widely applied in metals and cement production, waste incineration, etc. They produce major amounts of solid waste materials, such as slag and fly ash, and generate a vast amount of carbon dioxide. Mineral carbon sequestration in alkaline waste materials is a feasible solution because of high reactivity, on-site production, waste stabilization and low cost. Turning waste into construction materials is another route for transforming low-cost input materials into potentially high-value products. The production of a sorbent for wastewater and flue gas treatment is another promising industrial option for in-house treatment of waste streams.

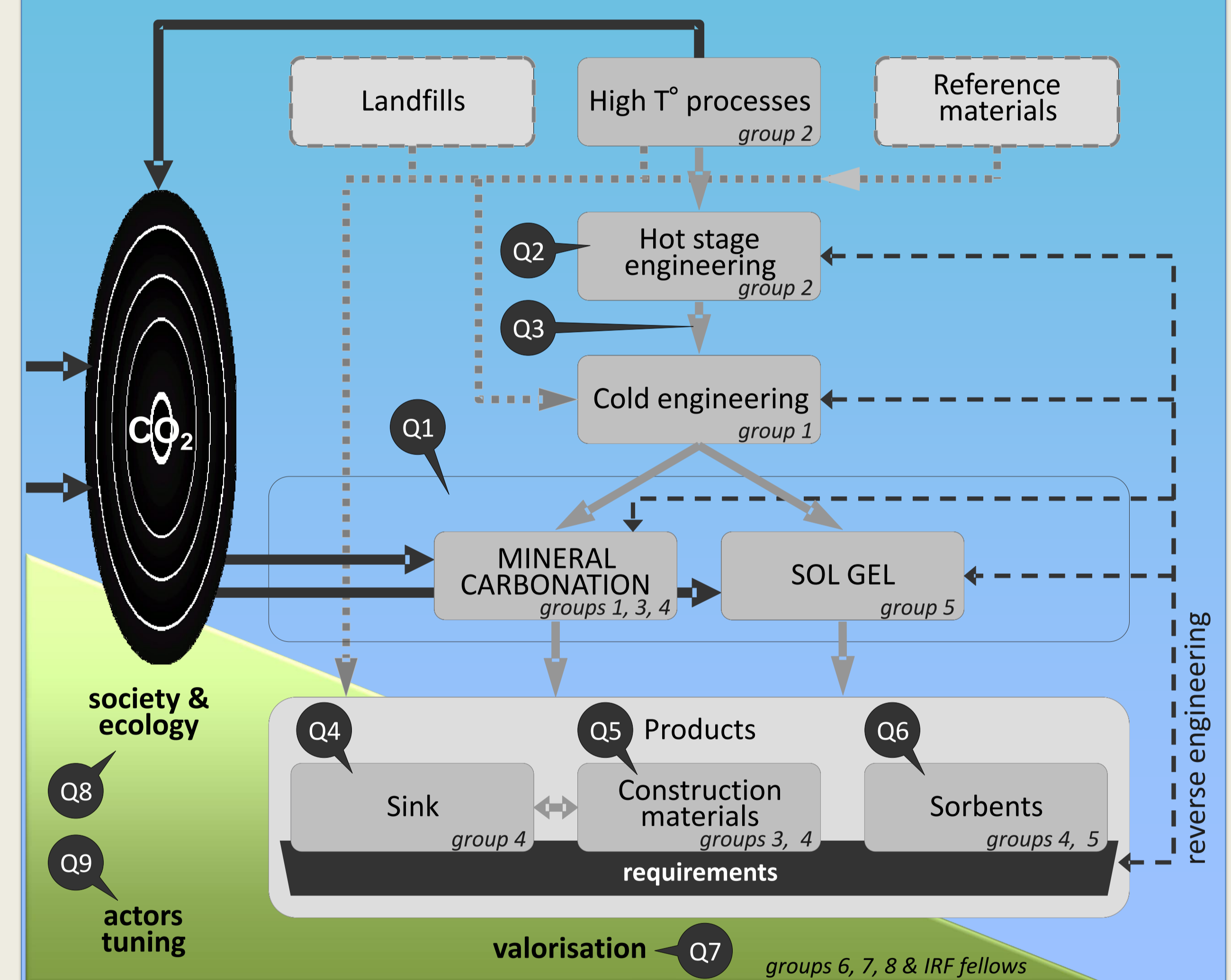
A successful approach requires a broad consortium with relevant expertise for the scientific investigation, but which at the same time can be easily tailored to a particular valorisation option that emerges. The Platform aims at this dual objective by bringing together all parties and by focusing on the challenging aim of valorising thermal process wastes into high-value products by intensified processes and with clear prospects on the economic and legislative feasibility, ecological benefits and societal relevance.

Approach 1: bring together the involved actors on the relevant topics

- Group 1: Chemical Engineering
- Group 2: Metallurgical Engineering
- Group 3: Civil Engineering
- Group 4: Geology
- Group 5: Surface Chemistry
- Group 6: Economy
- Group 7: Organisation Psychology
- Group 8: Law



Approach 2: perform research on selected topics



- Q1: How to achieve carbon dioxide sequestration: focus on process limitations and intensification?
- Q2: How to apply hot stage processing for property improvement of the cold product?
- Q3: How to combine cold physico-chemical treatment with hot-stage processing?
- Q4: How to make a sink for carbon dioxide?
- Q5: How to improve essential properties of construction materials using waste residues?
- Q6: How to produce mesoporous sorbents retaining heavy metals from solution and components from flue gas?
- Q7: Which are the different potential valorisation routes of selected residues?
- Q8: What is the societal and ecological impact of the proposed valorisation routes?
- Q9: How can a process of mutual tuning between the different actors involved in the production and use of thermal process by-products be enhanced?

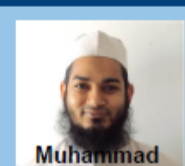
Approach 3: go beyond 'just' interaction

- Jointly identify new topics, find the common issues and take advantage of the complementary goals
- Strive for collaboration with other research centers and consortia
- Develop project proposals for Flemish/European/ in-house funding



Doctoral Projects 2010-2013

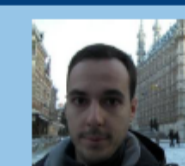
Research topic #1



Innovative construction materials incorporating waste

- integrated process cycle from hot residue to end-product
- reverse-engineering approach by performing actions upstream defined by downstream requirements
- application type is defined by the required performance and the potential of improved design or concept
- additional features: act as CO₂ sinks, isolation properties

Research topic #2



Innovative mineral carbonation routes

- combined goal of CO₂ sequestration, product quality improvement (strength, leaching), valuable materials formation
- optimal introduction of CO₂ along the hot-stage to cold-stage process
- focus on process barriers (rate and yield) by applying localized energy

Research topic #3



Sorbents and high-temperature residues

- development of a bifunctional sorbent for i) metal absorption in water treatment and ii) SO_x/NO_x adsorption in flue gas cleaning
- synthesis applying 'in-house' ingredients for sol-gel procedure
- treatment of loaded sorbent also 'in-house', thus yielding cheap and useful 2nd life

Research topic #4



Valorisation potential of high-temperature residues

- market analysis of valorisation routes
- identification of (economic, regulatory, social) stimuli and barriers to sustainable recycling
- full social cost including external environmental effects
- target an assessment simulation model integrating economy, ecology and multi-actor relationships

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