Optimal site-wide planning: The ammonia network of INEOS in Cologne

The goal is to develop a site-wide optimisation model to enable an optimal planning of the operation for the complete site. The ammonia network serves as a proof of concept.

Use Case

Different departments of optimisation and planning have to interact.

Information has to be shared across departments and business units and they have to be meaningfully linked.

Optimisation problem

- Constraints from distributed data sources
- Objective functions of the individual units/plants

Solving the large scale MILP

- Efficient solvers required
- Optimal schedule for site-wide operation

Modelling bottleneck

- Plant models need to be formulated
- Time consuming and tedious work

Input-output relations

- INEOS in Cologne on-site planning models
- Affine input-output relations identified from production data

The operation of the ammonia plant during the following month

- Planned shutdown of the ammonia plant
- Optimal operation has to be ensured for the subsequent processes
- Consider logistics (barges, train vessels) and energy prices

Minimise the cost for site-wide operation

\[ f(m, m', y, z) \]

Constraints:
- The mass streams on the site
- The operating modes of the ammonia plant
- The distribution of the ammonia to different tanks

Levels of buffers and storages

- The tank levels and the load assignments for the plants are plausible
- The data was validated with historic measurements

Liquefaction saving potential

- Usage of price forecasts
- Potential savings because of efficient usage of the buffer tanks, which requires less liquefaction

Demand-side management

- Use of price forecasts possible (Day ahead market)

Benefits for INEOS in Cologne

- Faster (re-)scheduling and planning of the site operation
- Taking into account customer relations
- Integration of supply chain and operations

Easy to use and to maintain
- Efficient data handling
- Intuitive visualisation
- Extensible to more plants/networks/customers

Requirements

- Flexibility exists for buffers, some plants/networks/customers
- Our optimiser is able to quickly re-compute a new optimal schedule
- We modelled the NH3 network of INEOS in Cologne
- An optimal site-wide schedule can be computed

We modelled the NH3 network of INEOS in Cologne

An optimal site-wide schedule can be computed

Customised tool chain for better planning

- Tight collaboration between the project partners
- Synergies of the tools enable an efficient workflow for optimal planning

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This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723575