Systematic Design of Process for the Sustainable Production of Anhydrous Isopropanol from Propylene

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Introduction

The compound isopropanol (IPA) is an important chemical used as feedstock and solvent for a large range of chemical compounds. The demand of IPA in some parts of the world is expected to increase in the near future. Therefore, the chemical process design of IPA is relevant to investigate, improve and optimize both concerning cost efficiency and environmental impact. Reducing the environmental impact and making the process more sustainable while satisfying the process specifications are the main focuses in the optimization of the base case design to obtain a more sustainable process.

Methods

This project comprises a preliminary conceptual process design of a plant facility producing anhydrous IPA from propylene via direct hydration. The process of completing the design is performed using a PSE approach. This is a systematic top down approach which decomposes the design problem into 12 tasks. The last tasks concern optimization of the plant design by targeting bottle-necks and sustainability issues using computational simulation tools.

Results

The computational tool SustainPro is used to identify bottle-necks of the process in order to make the process more sustainable. The identified bottle-necks are:

1. Energy Consumption
2. Distillation column designs

A heat exchanger network system (HENS) was developed to evaluate whether energy consumption and waste can be reduced to improve sustainability issues for the process.
The following results and savings are obtained from the HENS analysis:

	Duty [MW]	*Cost [$/y]*
Base Case	113.4	6.0
HENS Case	82.3	4.8
Savings	31.1	1.3
Savings [%]	27.4	20.9

Table 1 Results of HENS analysis

From the HENS analysis it can be seen that utilities can be reduced resulting in increased profit and a more sustainable process with less environmental impact.

Conclusion

By using the computational software SustainPro a Life Cycle Analysis was made and bottlenecks were identified. The profitability and sustainability of the process can be increased considerably by performing heat integration.