Thermodynamic evaluation of a pharmaceutical synthesis step in a batch and continuous micro reactor

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Abstract

In the fine chemical and pharmaceutical industry, there is a tendency to replace batch production processes by continuous production processes. Using micro reactors for continuous production has different advantages. Most known advantages are the increased surface-to-volume ratios leading to lower cooling and heating power requirements. The better control of heat transfer can also result in higher efficiencies of chemical conversions. These advantages should directly lead to a decrease in the total resource requirements. However few thorough quantitative information is available on how much resources are saved by using continuous production processes instead of the batch alternatives[1].
In this work a thorough comparison is made of a specific synthesis step from the pharmaceutical company Janssen Pharmaceutica Belgium, part of Johnson & Johnson using the batch and the continuous process. Exergetic life cycle analysis as used in Van der Vorst et al. (2009)[2] is used for the evaluation of both production processes. First the resource requirements at the process level are taken into account. Second, all resource requirements over the plant level, including the production of utilities and the waste treatment are taken into account. Third, the resource requirement over the overall industrial network is evaluated (cradle-to-gate) and compared for both alternative production methods. This study also illustrates the possibility, the advantages and the impact of quantifying both energy and material resource intake for chemical processes. Exergy analysis and the CEENE method are here the unique scientifically sound tools enabling the quantification all kinds of resources and products on the same scale and to take into account all the resources for a proper evaluation[3].

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References

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