Impact of process re-design on sustainability in pharmaceutical small molecule manufacturing: A case study

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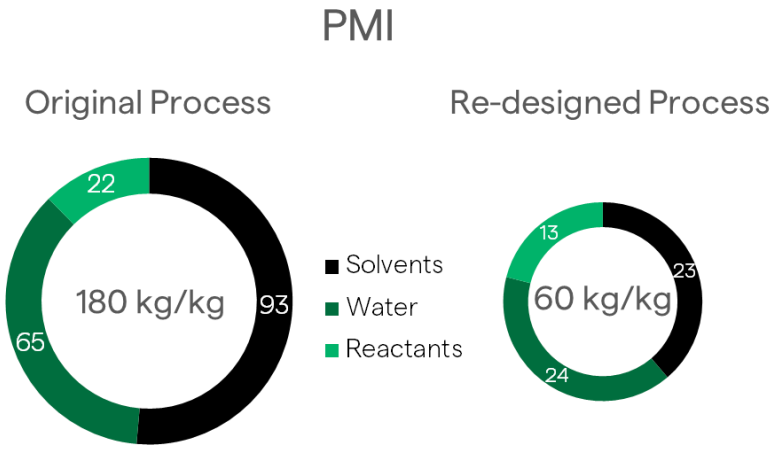
A recent study revealed, that the pharmaceutical industry is significantly more emission-intensive than the automotive industry[1]. In a cradle-to-grave perspective, the impact of supply chain on the carbon footprint of pharmaceutical companies operations by far exceeds the impacts related to waste production and treatment[2][3]. Therefore, it is of highest priority that pharmaceutical manufacturing becomes more efficient with respect to the use of resources.
In this work, we extensively describe the optimization of the manufacturing process of a pharmaceutical intermediate. We demonstrate without changing neither reactants nor synthetic route, that yield can be improved substantially via suitable reaction engineering. This in combination with a rigorous review of the work-up and isolation procedures leads to a reduction of the process mass intensity (PMI) by more than 60 % with respect to the original commercial process. Finally, we show that the implemented optimizations come along with a net increase in quality of the obtained intermediate.



[1] L. Belkhir, A. Elmeligi, *Journal of Cleaner Production*, **2019**, *214*, 185-194.
[2] C. Jimenez-Gonzalez, C. S. Ponder, Q. B. Broxterman, J. B. Manley, *Org. Process Res. Dev.* **2011,** 15, 4, 912–917.
[3] *Lonza Sustainability Report 2021*, **2022**, 35 ff.