

The Challenge of Transforming the Chemical Industry – Contribution of the WSS-Research Centre catalaix

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Abstract

The chemical industry provides us with invaluable products for our health, nutrition and our modern lifestyle. For the future sustainable chemical industry, climate-neutral processes and a transition to sustainable feedstocks are of paramount importance. Achieving this transformation poses an enormous challenge. Especially the defossilization of value chains requires innovative approaches and a holistic transformation of linear material flows towards a circular economy. In particular, this implies a selective recovery of all raw materials at the end of life of the manifold chemical products. However, this fundamental transformation of production pathways requires a flexibility in value chains that is not reflected in current approaches. The currently targeted one-dimensional circular economy must therefore be evolved using a novel "Open Loop" approach to enable the urgently needed interconnection of different material flows. The Open Loop approach allows raw materials to be tailored during recovery and fed into other value chains and material cycles, thus paving the way for a flexible, multidimensional circular economy.

The WSS-Research Centre catalaix has the overall objective of developing the Open Loop approach for the establishment of a multidimensional circular carbon economy. To this end, catalaix is dedicated to research and development of innovative and high-performance technologies for the catalytic conversion of complex chemical compounds into a flexible chemical feedstock platform for a cross-linked circular economy. In the case of plastic waste, the innovative yet challenging approach of the Open Loop concept is to (1.) preserve the chemical synthesis efforts contained in the highly functional polymers, and to selectively transform the polymers into monomers or other valuable chemical platform molecules that can either be re-used to produce pure plastics or to produce alternative products in other value cycles. This new access to diverse and sustainable intermediates with increased added value, which can in the end be flexibly incorporated into chemical products and production processes, is realized in the Open Loop approach by integrating renewable energy and sustainable carbon sources into the material cycle. Another challenge arises from (2.) the utilization of diverse waste streams and the corresponding presence of mixed fractions of chemically complex compounds, low-functional polymers, and composite materials. catalaix addresses this challenging mixture of complex compounds through the innovative cross-disciplinary combination of thermo-chemical conversion to functional intermediates and subsequent conversion by chemo-, bio- and electrocatalysis. A further challenge is (3.) a modularization based on new chemical building blocks, which will combine desired material properties with environmental compatibility and a straightforward raw material recovery (benign-by-design).