Chemical recycling of hard to recycle mixed waste plastics

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The chemical recycling via pyrolysis of mixed waste streams is challenging. One critical issue is that direct pyrolysis of this stream yields a pyrolysis oil of low quality, unsuitable for processing in petrochemical complexes, mainly due to the presence of hetero-atom containing components and other impurities.
This research shows the technological feasibility to recycle these hard-to-recycle streams into “virgin” chemical building blocks. First the waste stream is divided into two streams by means of a two-step negative NIR optical sorting to remove all (residues) but PE and PP.
The first stream, the olefin rich stream, is converted into high-quality pyrolysis oil *via* pyrolysis in a fluidized bed reactor. The high-quality pyrolysis oil is suitable for conversion into naphtha via catalytic hydrogenation. The naphtha can be further processed in existing naphtha crackers to produce a wide variety of petrochemicals, including ethylene and propylene.
The second stream, the olefin poor stream, is converted into mixed aromatics *via* Integrated Cascading Catalytic Pyrolysis (ICCP). The mixed aromatics are suitable for processing in existing aromatics plants to produce benzene, toluene, and xylenes.
The elegance of the approach outlined in this research is that the complete pallet of petrochemical building blocks, olefins and aromatics, are produced from a low-quality, hard to recycle plastic waste stream, thereby proving that full circularity of all plastic waste streams is technologically feasible.

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