

Abstract for Advanced Recycling Conference

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Title: PureStep™: Enabling scalability on chemical recycling through a proven upgrading technology.

Over the past several years, a range of technologies has emerged to support chemical recycling of plastics. Today, however, the key challenge is scalability: proven, industrially reliable solutions that can convert variable plastic waste streams into circular streams at commercial scale.

One promising pathway is the transformation of contaminated mixed plastic into pyrolysis oil to enable feedstock circularity, but the remaining issue is how to convert this highly contaminated oil into on-spec circular feedstocks with minimal yield loss. Topsoe's PureStep™ technology addresses this critical bottleneck by enabling the direct upgrading of full-range plastic pyrolysis oil (PPO) into high-quality circular feedstocks suitable for existing plastic production infrastructure.

While pyrolysis and other liquefaction technologies unlock the first step of chemical recycling, the resulting oil typically contains a broad boiling range and significant levels of impurities (such as sulfur, nitrogen, oxygenates, halogens, and metals) which has shown limited integration into petrochemical complexes. PureStep™ overcomes this by applying Topsoe's extensive experience on advanced hydroprocessing and catalyst technology to efficiently remove impurities. Analyses techniques have been developed for speciation of selected contaminants, and fractionation studies have been performed showing that major contaminants do not occur in predetermined boiling point fractions across different mixed waste plastic derived oils. Understanding of specific impurities inherent to plastic derived oils gives valuable insights into the required hydroprocessing.

The technology has reached commercial maturity (TRL 9), demonstrated in operating units with major petrochemical partners in Europe. These installations confirm stable performance, specification compliance, and integration into real production environments.