Technical Abstract — *Silicone Recycling: A Global Vision*

J.Munsch, A. Boulègue Mondière, C. Des Courières

Silicone materials are increasingly critical to high-performance applications across renewable energy, e-mobility, healthcare, and construction. Their highly crosslinked structures and inherent thermal–oxidative stability pose significant challenges for end-of-life management. To address this, Elkem Silicones has developed an integrated recycling strategy combining controlled chemical depolymerization and engineered mechanical regeneration to recover value from diverse post-industrial and post-consumer streams.

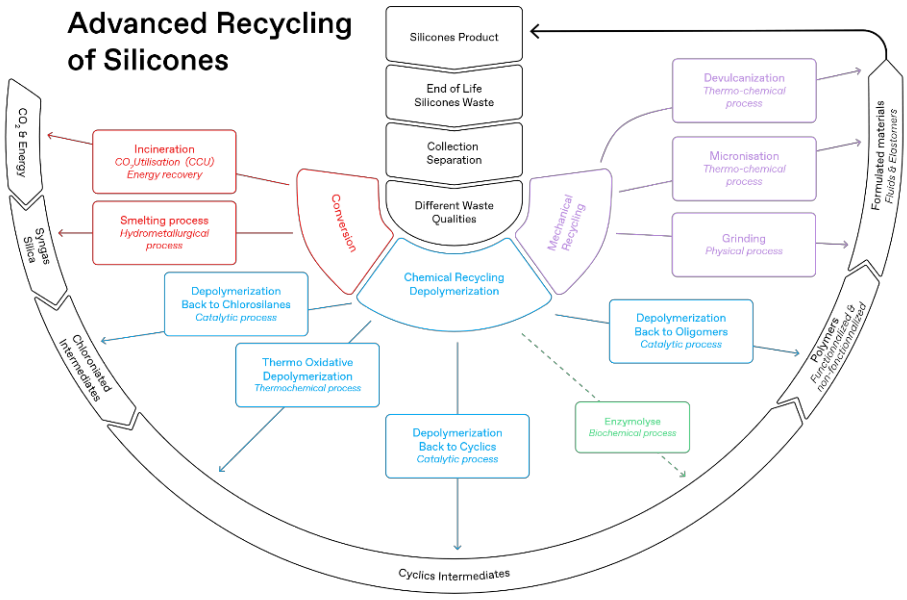
Chemical recycling relies on *depolymerization mechanisms* that revert silicone well-defined intermediates species (Chlorosilanes, Monomers, oligomers). These innovations and their advances are reported in *Science (2025)*, *Green Chemistry (2023)*, and *Polymer Degradation and Stability (2025)* — demonstrating the feasibility of controlled Si–O backbone scission and recombination control in silicone depolymerization. New products coming out of depolymerization process are already in the market, offering 100% recycled content and up to 70% carbon footprint decrease[1].

Mechanical recycling approaches are evaluated through different processes to obtained the best recycling to reincorporate in new formulas. Recent developments show incorporation rates exceeding 50% while maintaining high mechanical integrity, supporting large-scale circularity for high-performance elastomers.

These efforts are reinforced by collaborative R&D with SMEs and academic laboratories, as documented in the REPOS[2], RENOV[3], PLANETS program on chemical depolymerization and mechanical recycling initiatives.

Pilot-scale demonstrations in Europe validate the industrial scalability of both depolymerization and mechanical regeneration pathways, supported by patented processes and multi-partner collaborations.

This presentation details the structure–process–property correlations underpinning regenerated silicones, outlines the systemic methodology applied to ensure robustness of waste treatment, carbon footprint reduction, high performances of recyclates.



Based on the schema «Diversity of Advanced Recycling» developed by Nova Institut and published by Renewable Carbon, adapted by Elkem Silicones R&D in the case of silicones.

[1] Elkem Achieves Key Milestone in Circular Economy for Silicones | Elkem.com
[2] REPOS – Innovative depolymerization technology for silicones - cefic
[3] A circular economy project at Elkem | Elkem.com