Transforming sustainability in the composite industry

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Rise of thermoset composites

Thermoset composites have revolutionized industries such as automotive, aerospace, marine, and wind by offering unmatched strength, lightweight properties, and corrosion resistance. These materials have become indispensable in applications ranging from wind turbines to aircraft structures, enhancing efficiency and durability. However, their widespread adoption has also highlighted a critical challenge: the non-recyclability of thermoset composites.

Problem of non-recyclability

Despite their numerous benefits, thermoset composites face a significant drawback – they are non-recyclable. The waste generated during manufacturing and at the end of their lifecycle creates ecological and environmental challenges. Current disposal methods such as landfilling, pyrolysis, incineration, etc. are either not environmentally friendly or are energy-intensive, failing to derive value from waste materials. It does not only contribute to increasing landfill waste but also results in lost opportunities to recover valuable materials like carbon fibre and epoxy matrices, thereby exacerbating environmental degradation.

The non-recyclability of thermosets is particularly problematic because traditional recycling methods fail to address their inherent cross-linked structure, making them unsuitable for reuse and reintegration into production ecosystems. This limitation underscores the need for innovative solutions that can transform thermoset waste into valuable resources.

Introducing *Recyclamine* technology

Recyclamine technology is a groundbreaking innovation designed to address the critical challenge of non-recyclable thermoplastic. By integrating unique epoxy resins and curing agents with meticulously engineered cleavage points at cross-linking sites, Recyclamine enables the conversion of thermosets into thermoplastics through recycling process. This allows the recovery and reuse of valuable components such as carbon fibre, glass fibre, and epoxy matrices.

Potential industries

Wind energy: revolutionizing turbine blade sustainability

The wind energy sector faces a critical sustainability hurdle: over 43,000 wind turbine blades are expected to reach end-of-life annually by 2050, with most destined for landfills. Traditional blade materials – fiberglass-reinforced epoxy resins – resist recycling due to their thermoset nature. *Recyclamine*-enabled epoxy systems allow blades to be chemically disassembled, recovering both the resin matrix and reinforcing fibres.

Surfboard manufacturing: pioneering closed-loop production

Surfboard production has long relied on fiberglass-reinforced epoxy resins, generating waste during both manufacturing and end-of-life stages. *Recyclamine* technology is transforming this niche industry through fully recyclable composites.

Ski production: collaborative innovation for circularity

The ski industry's reliance on carbon fibre and fiberglass composites has made recycling nearly impossible – until now. A ski developed with *Recyclamine*-based resins, exemplifies this shift. The ski comprises 62% recycled materials, including a recyclable epoxy matrix that dissolves in acid baths, allowing the recovery of carbon fibre layers and aluminium edges.

Automotive components: light-weighting meets recyclability

The automotive industry's push for lightweight composites to improve fuel efficiency has been hampered by recycling challenges. *Recyclamine*-enabled epoxy systems address this by allowing carbon fibre-reinforced components to be chemically recycled.

Sports equipment: reducing high-tech waste

High-performance sports equipment, from tennis rackets to bicycles, increasingly relies on carbon fibre composites. *Recyclamine* technology enables the recovery of carbon fibres and resins from retired gear.

CONCLUSION: Cross-industry synergies and future directions

Recyclamine technology represents a paradigm shift in materials science, offering scalable solutions to the thermoset recycling crisis. It not only addresses manufacturing and end-of-life waste but also facilitates the reintegration of recycled materials back into production ecosystems. This innovation reduces environmental impact while promoting circularity in material usage. It is setting a new benchmark for sustainability in the chemical industry, paving the way for cleaner production processes and a greener future.

The technology stands as a testament to the power of innovation in transforming environmental challenges into opportunities for growth and sustainability.