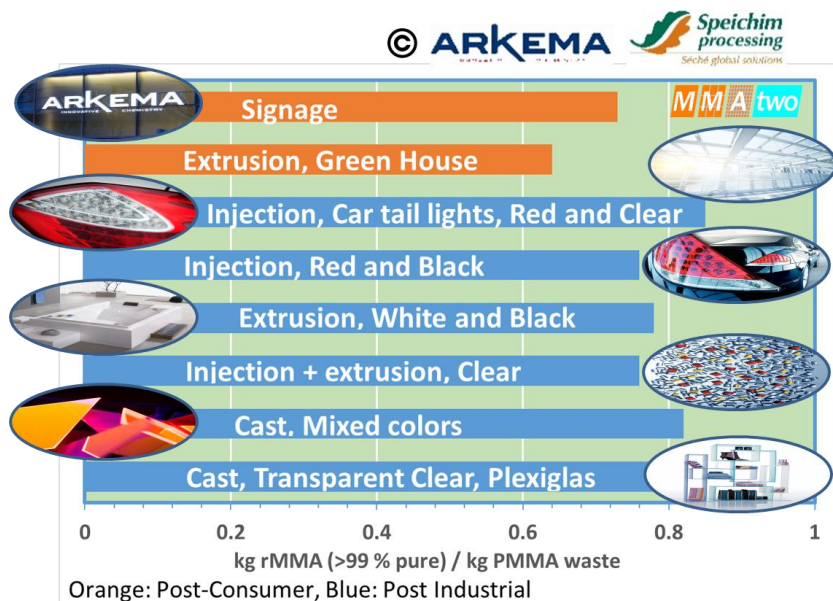


High Polymer to Polymer yields



**High monomer purity:
99.8 wt %**

Demonstrators made with Regenerated MMA



Transparent Cast flat sheet



Caravan Window



Composite Kitchen sink



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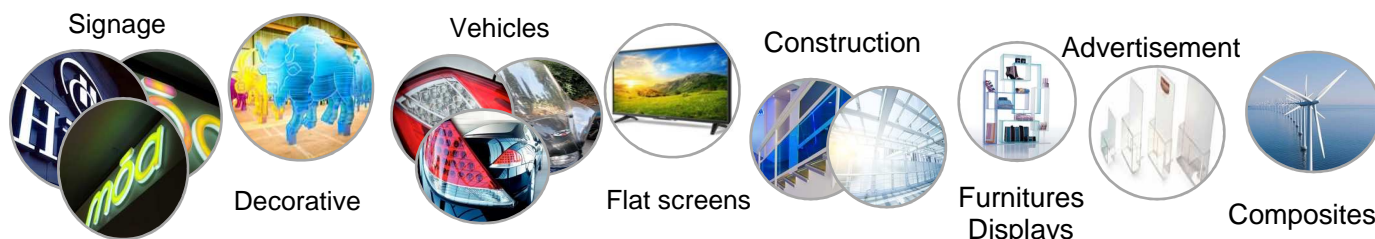
ARKEMA
INNOVATIVE CHEMISTRY



HEATHLAND

MMAtwo – Application to Innovation Award “Renewable Material of the Year”

PMMA Applications: A broad spectra of different PMMA waste types was pretreated into ready feedstock for conversion into crude rMMA. **Heathland, Ecologic, Arkema, Delta Glass, Certech, and Comet.**



Word by Chair of Executive Board and Advisory Board, Jean-Luc DUBOIS

PolyMethyl MethAcrylate (PMMA) is a well-established polymer known for its optical properties. About 300 000 tons of PMMA are produced in Europe every year, or close to 1 billion Euro of market value. It is estimated that currently only 30 000 tons of PMMA waste is collected to be recycled annually in Europe, although PMMA can be turned back into its monomer (**MMA**) by thermal depolymerization, thus saving precious resources and CO₂ emissions. MMAtwo's challenge consists in converting PMMA post-industrial scraps and End-of-Life wastes into high quality **regenerate Methyl Methacrylate** and therefore contribute to the circular economy.

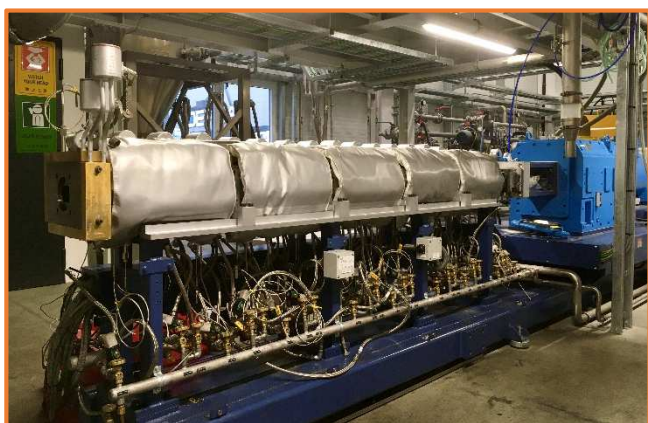
MMAtwo is on track to have a major impact on the way we handle PMMA waste within the European Union. MMAtwo's innovative technology has successfully produced crude and purified MMA. The combined technologies provides solutions to convert all types of PMMA waste, including difficult to recycle End-of-Life PMMA waste, into virgin-like quality MMA. Conversion to MMA by means of depolymerization offers huge advantages. MMAtwo therefore creates a viable and competitive business whilst saving resources allowing waste to be regenerated cycle after cycle. MMAtwo is set for successful commercial deployment of its technology.

Regenerated MMA from MMAtwo has already been tested in several applications where it demonstrated equivalent performance than virgin MMA. Samples are already available, and the product is expected to be placed on the market in the coming years.



Top: Virgin MMA versus Crude MMA

Bottom Purification pilot plant: left: Crude MMA, right: Regenerated MMA.



MMAtwo's Pilot plant, based on JSWE's twin-screw extruder technology, installed in Düsseldorf

PMMA depolymerization has moved from the laboratory to the pilot scale, with 3 test periods in June, October and November 2020. During these tests, in which partners **Arkema, Heathland, Japan Steel Works Europe, Suster and PDC** contributed, several different types of PMMA (Post-Industrial and End-of-Life) materials have been processed. The unit operated better at above design capacity, and the limitation was the storage capacity. The **pilot was operated above 1000 tonne annual capacity** for several hours, producing high quality crude MMA.

During the November 2020 tests, out of a dozen of materials, End of Life WEEE waste was processed and clear crude MMA was produced. A first composite material was also depolymerized which will be also further purified in the coming month

Interested to contribute to the MMAtwo project or to stay informed about all our news? Complete the following form: www.mmatwo.eu/contact/

Regenerated MMA: Renewable Material of the Year

Speichim moved the purification, from laboratory scale to the pilot scale, on the crude MMA obtained from the depolymerization trials done in **Japan Steel Works Europe**. The same excellent results were obtained at both scales (laboratory and pilot). Purity above 99.5 % of the recovered MMA have been achieved, and the **first large batch at several 100 kg reached 99.8%** (see table on the right). The recovered MMA was successfully tested in several applications, such as Cast sheets production, Caravan window, Kitchen sinks and composites (see examples below). Purified regenerated samples can be made available for further evaluation.

Evaluation of various rMMAs from lab scale depolymerization, as well as the purified pilot plant rMMA, has been finalized and validated for: structural **composite** applications by **Arkema** and for **kitchen sink** applications by **Plados Telma** (see pictures on the right). **Certech** showed that the main odorous intensities of structural composite materials is equivalent to what is observed with virgin materials, and originates from residual monomers and comonomers, recombination products and most likely degradation products.

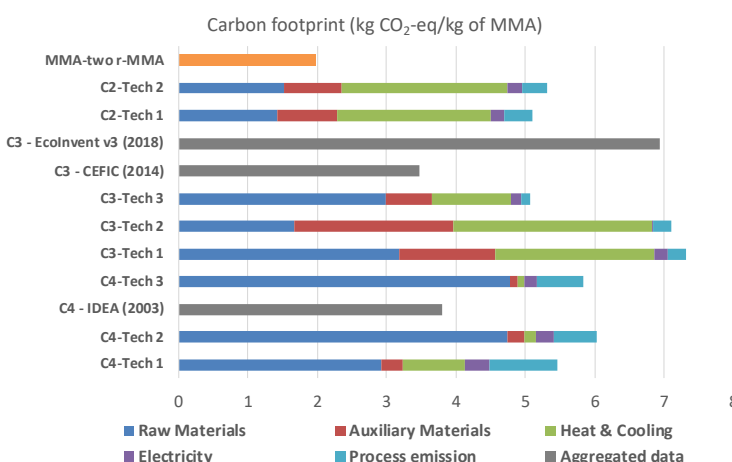
Analysis of regenerated MMA	
Items	Figures
MMA purity (by GC)	99.8 %
Acidity as Methacrylic acid	< 5 ppm
Water content	400 ppm
Colour	≤ 10 APHA
Methyl Acrylate	< 0.1 %
Ethyl Acrylate	< 0.1 %
Methyl Isobutyrate	< 0.1 %
Density at 20 °C	0.943
Stabilizers: Topanol A or MEHQ	as requested

Left: preparation of fully recycled syrup (mixture of pilot plant rMMA and post-industrial rPMMA scrap), **center and right:** first prototype sinks ("Avena" and "Deep Black" compositions) obtained with said syrup in **Plados Telma**.



The purified rMMA obtained during the first depolymerization pilot trials mentioned above was used in production by **Delta Glass** in order to successfully manufacture **standard sheets with dimensions 1600 x 2600 x 3 mm³** from which a **first caravan window** was produced (see pictures).

Left: industrial cast sheet made from pilot trial rMMA. **Right:** caravan window obtained from the same cast material.



Initial results for MMAtwo technology show an impact reduction -44% to -73% depending on the virgin technology considered.

LCA of the MMAtwo technology and benchmark technologies, are performed by **Quantis**, taking into account the different routes for virgin MMA production and including reference datasets from recognized environmental databases

- Cx routes were developed on mass end energy balance (with no energy optimization) – C2: Ethylene-based, C3: Acetone-based, C4: isobutylene/t-butanol-based routes
- Ecolnvent and CEFIC datasets represent European average production from real plants
- IDEA dataset represents Japanese average production from real plants (C4).

Virgin MMA Carbon footprint ranges from 3.5-7 kg CO₂-eq/kg MMA

UGent organized a workshop on PMMA recycling in September 2020, and is preparing materials for education. Contact **Ayming** which organizes the project communication (website and social network)) for more information



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