

ADVANCED RECYCLING OF PVC

Chemical Recycling Summit 2022

Moerdijk, 22 November 2022
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INOVYN: European Leadership

Vinyls

Leadership positions in Europe

#1

General Purpose Vinyls

#1

Specialty Vinyls

2x larger than next European competitor

Others

Leadership positions in Europe ⁽²⁾

#1

Chlorine

#1

Caustic Soda

#2

Caustic Potash

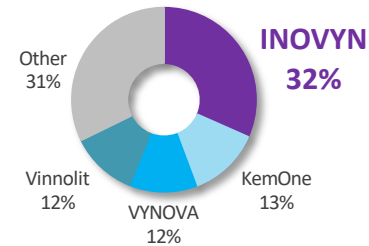
#1

Epichlorohydrin

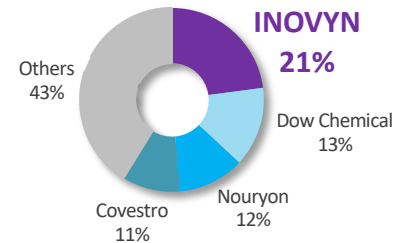
#3

Chloromethanes

All PVC ⁽¹⁾



Caustic Soda ⁽³⁾



Source: IHS, company information

1. Capacity market share for EEA (2017), excluding Oltchim

2. Based on management estimates for merchant market share

3. Merchant market share for caustic soda liquor (EEA 2016)

Circle Project focusing on advanced recycling

Limits to mechanical recycling of PVC waste material

- Slow degradation of mechanical properties/qualities per cycle
 - In principle max up to 10 cycles
- Economical and technical constraints to separate mixed and contaminated PVC
 - High variety in PVC applications
- Composite materials can't be recycled back to its original applications
 - Composite materials recycled into downgraded applications
- Legacy additives are also recycled
 - Recycled PVC with legacy additives content following legislation

INOVYN's recycling technologies development

Dissolution



Development based on our Vinyloop® technology

- 2001 – 2018: Vinyloop® Industrial plant at Ferrara (I)
- Several years of experience
 - Fibers separated from PVC
 - Elimination of residual contaminations
 - Production of rejuvenated PVC: 8 500 T
- Nominal capacity : Waste : 10 000 T
 Rejuvenated-PVC : 8 500 T
- 2022 - present: R&D project to extract legacy additives from PVC waste materials



INOVYN's recycling technologies development

Pyrolysis

Development based on polyolefins' technology



- Most pyrolysis technology providers avoid PVC in their feedstock as chlorine is an issue for steamcrackers processing



- However, e.g., Pryme Cleantech and Arcus Greencycling do accept some PVC, but it is neutralized



- INOVYN working on pyrolysis technology to process 100% PVC waste
 - ✓ 2-step process, first dechlorinate the PVC to recycle HCl and then pyrolysis to recover C for ethylene production
 - ✓ Partners identified
 - ✓ r-PVC having same characteristics as virgin PVC

INOVYN's recycling technologies development

Gasification

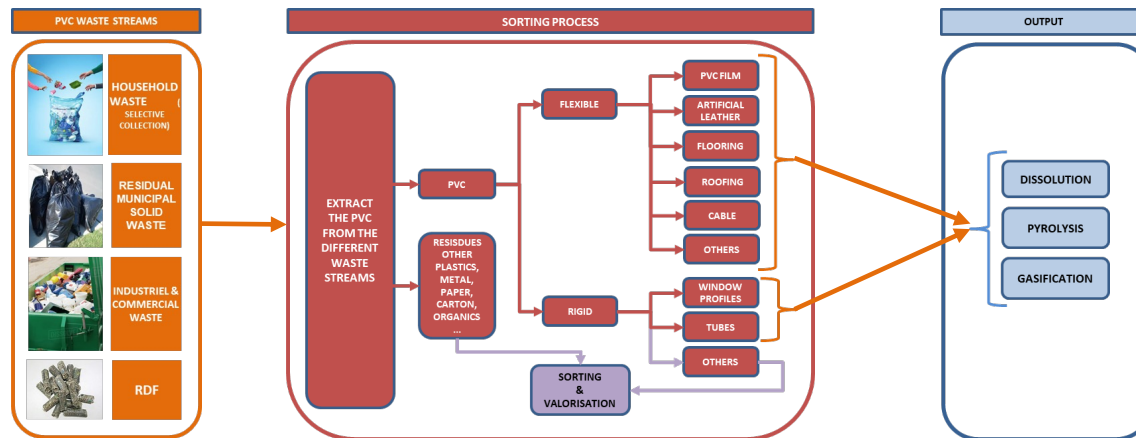
Development based on diluted PVC feedstock



- In Japan, gasifiers in operating on chlorine containing (~1%) waste feedstock
- In Japan, 1 gasifier was operated with 10% PVC waste feedstock
- INOVYN working on gasification technology to process 100% PVC waste
 - ✓ Partner identified
 - ✓ Pilot plant tests successfully performed
 - ✓ Upscaling being discussed
 - ✓ Recycle HCL and convert syngas to ethylene
 - ✓ r-PVC having same characteristics as virgin PVC

PVC waste feedstock collection and sorting

No tracing of PVC waste sent to landfill and incineration



- Most PVC waste materials are present in very diluted streams
- INOVYN working on sorting out of mixed and individual PVC applications
 - ✓ Partners identified
 - ✓ Initial pilot plant tests successfully performed

Circle Project on advanced recycling of PVC

INOVYN's ambition in Low Carbon Solutions

- Meet the new ambitions of the European Commission in terms of recycling
- Extend the range of possibilities beyond mechanical recycling, which is partly threatened by legislative developments (legacy issues)
- Develop advanced recycling technologies to recycle HCl, carbon and additives, knowing that today there is no turnkey technology for PVC
- Identify and secure PVC waste stock, knowing that there is no traceability of PVC waste going to incineration or landfill
- Have a first industrial unit by 2030