

HYDROGENATION CATALYSTS

the Power of Joint Development

Combining decades of experience, Evonik and Westlake - Vinnolit have developed a custom hydrogenation catalyst designed to reduce the harmful byproducts of Vinyl Chloride Monomer (VCM) production – the building block of one of the world’s most in-demand thermoplastics: Polyvinyl Chloride (PVC). The technology facilitates a more economically and environmentally friendly approach to PVC production.

With a diverse range of applications including construction, medical products, electronics, consumer goods and automobiles, it is no surprise that PVC is in huge demand across the globe. In 2022, this demand exceeded 48 MMt* and is forecast to grow to nearly 60 MMt by the end of 2025**.

As with any polymer, PVC cannot exist without its monomer: Vinyl Chloride Monomer (VCM). In fact, more than 99% of global VCM production is consumed for PVC production.

However, production of VCM creates acetylene (C_2H_4), which in turn forms harmful chlorinated byproducts that are costly to remove and discard.

The good news is that Evonik and Westlake - Vinnolit have pioneered a more cost-effective and environmentally friendly method for VCM production – through hydrogenation technology – tested and used in Westlake - Vinnolit’s commercial plants. This approach improves both the economic and sustainability profile of PVC manufacturing.

- VCM production creates harmful unwanted byproducts
- Noblyst® catalysts reduce toxic by-product formation, investment costs and CO₂ emissions
- Hydrogenation catalysts can eliminate ~860 tons of toxic chlorinated byproducts in 300 kta production
- C₂H₂ conversion rates of more than 98% can be achieved
- Return-on-investment period as little as two years
- 20% lower palladium content compared to conventional options

*S&P Global, 2022 ** Statista, 2024

Through the development of fixed-bed catalysts – Noblyst® E39 – tailored to the selective hydrogenation processes involved in the removal of acetylene within VCM recycle streams, these undesired byproducts can be avoided, while helping to lower the costs involved in their separation and disposal.

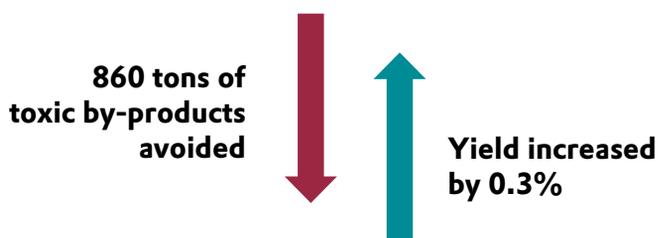
Furthermore, Evonik’s catalysts have been developed to contain smaller amounts of the required precious metals – 20% lower palladium content compared to conventional options – translating to lower investment costs for producers, and fewer CO₂ emissions.

The palladium from Noblyst® catalysts can also take part in the brand’s full precious metal service loop.

The majority of acetylene removal is managed by the effective method of selective hydrogenation, helping to prevent approximately 860 tons of toxic chlorinated byproducts in 300 kta production of VCM.

Calculation for 300 kta VCM unit

Hydrogenation unit	without [%]	with [%]	
1,2 Di-trans	0.010	0.002	
CCl ₄	0.101	0.067	
1,2 Di-cis	0.012	0.008	
1,1,2 Trien	0.035	0.002	
Total Low Boilers	0.158	0.079	Δ = -0.079
Tetrachlorethylene	0.112	0.001	
1,1,2,2 Tetrachlorethane	0.130	0.034	
Total High Boilers	0.242	0.034	Δ = -0.207
Total By-products			Δ = -0.286
1,2 EDC	98,669	98,921	Δ = +0.252



To facilitate this process, a noble metal palladium (Pd) catalyst is commonly used, as it boasts the major benefit of being able to adsorb large amounts of hydrogen.

Using a suitable hydrogenation catalyst like this, acetylene conversion rates of more than 98% can be achieved – and the return on investment can be as little as two years.

Noblyst® E39 has been developed as a high-performance palladium on silica catalyst, with benefits that include superior chemical reactivity and ethylene selectivity, as well as a long catalyst lifetime.

The series was designed specifically for the selective hydrogenation of acetylene-to-ethylene within the VCM production process, improving ethane dichloride

selectivity and minimizing byproduct formation in the oxychlorination step.

Through these advancements in hydrogenation technology and catalyst development, ethylene recycling and the use of lower palladium catalysts offer clear ways to decrease production costs and the associated environmental impact.

Evonik and Westlake - Vinnolit are helping producers avoid toxic byproducts, reduce CO2 emissions and increase cost savings. Embracing innovation allows the VCM industry to meet increasing demand while establishing a more economical, resourceful and sustainable production process, in turn, creating a positive flow-on effect for the wider PVC market.

To discover more about how Evonik Catalysts is driving a broad green agenda, [click here](#).

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