

CASE STUDY

Enabling More Efficient Ethylene Oxide Production: METEOR™ EO-RETRO 2000 Catalyst



Project Name: Enabling more efficient ethylene oxide (EO) production

Product: METEOR™ EO-RETRO 2000 Catalyst

Project Description: The project demonstrates that the adoption of an advantaged catalyst in PETRONAS' world-scale EO plant can result in an increase in plant performance. This is due to more effective reduction in energy intensity and carbon emissions because of a higher-performance catalyst. Results of the technology change are verified by a third party. PETRONAS Chemicals Glycols is the first carbon savings contributor to the Official Carbon Partnership between Dow and the International Olympic Committee.

Project Start: 2015

Crediting Period: 6 years (2015-2021)

Collaborator: PETRONAS Chemicals Glycols

Location: Kerteh, Terengganu, Malaysia

Why Beyond Business as Usual? Upgrade to a more effective catalyst for reduced direct CO₂ emissions and improved process efficiency.



METEOR™ EO-RETRO 2000 – a more efficient catalyst

Dow developed the Most Effective Technology for Ethylene Oxide Reaction (**METEOR**) catalysts to increase the performance and reliability of the EO production process while helping to reduce energy consumption and CO₂ emissions. By benchmarking competitive catalysts, our team discovered that the Dow METEOR™ EO-RETRO 2000 (MR2000) Catalyst has a much higher tolerance for certain challenging operating conditions and can deliver a higher EO selectivity over catalyst life cycle versus competitive catalysts under similar conditions. The performance advantage could generate significant value for the user.

A catalyst with a higher EO selectivity also helps reduce CO₂ emissions during manufacturing by requiring less raw material. It is possible for a typical 500 KTA ethylene oxide/ethylene glycol plant to reduce 60,000 MT of carbon dioxide (CO₂) over a 3-year catalyst life cycle by switching to MR2000 Catalyst. During one year of use in a targeted world-scale EO plant, it is estimated that the MR2000 Catalyst can enable emission reductions that are comparable to taking more than 10,000¹ passenger cars off the road in the U.S. for one year.

Dow's MR2000 Catalyst has been used successfully since 2013 at several Dow, Dow affiliate and Dow joint-venture EO plants. MR2000 Catalyst is retrofittable to most of the world's existing EO plants and is characterized by high catalytic activity and selectivity to EO.

Dow METEOR™ EO-RETRO 2000 (MR2000) Catalyst

The Dow MR2000 Catalyst is a high-selectivity, high-activity, silver-based catalyst for EO production. It reduces direct CO₂ generation (and hence minimizes CO₂ as byproduct) and can also improve process efficiency by reducing energy usage in the downstream separation phase of EO production. It is robust and flexible and can be installed at different EO plants regardless of the plant's age, design technology and retrofit history. Learn more: www.dow.com/en-us/sports/sustainability/ioc-carbon-partner/industrial

To meet the goals of the Paris Climate Agreement and keep global warming below the 2°C limit, global greenhouse gas (GHG) emissions need to be halved every decade from now until 2050. Achieving this requires transformative change and deep decarbonization across industries. Technological innovation plays a key role in decreasing emissions while continuing to meet the needs of a growing world population.

Ethylene oxide (EO) is one of the most important chemical raw materials because it is essential for the manufacturing processes of diverse consumer goods used daily around the world, including textiles, detergents and polyurethane-based products, such as mattresses and sealants, or polyethylene terephthalate (PET). Global demand for EO has grown significantly in recent years, a trend which is expected to continue as a result of economic and population growth.

The EO production process is energy intensive and creates direct CO₂ emissions, making it critical to deploy transformative technologies that go beyond business as usual.

¹<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Improved performance at PETRONAS Chemicals Glycols' EO plant

In 2015, PETRONAS Chemicals Glycols (a subsidiary of PETRONAS Chemicals Group Berhad which operates the EO production facility in Kerteh, Terengganu, Malaysia) became Dow's first customer to use the MR2000 Catalyst. The Group is committed to reducing emissions of GHG into the atmosphere, in line with PETRONAS' Climate Change Position and Carbon Commitments to efficiently generate affordable and reliable energy.

Driven by this commitment to sustainable production growth and operational excellence, PETRONAS Chemicals Glycols' catalyst upgrade has seen improvements in lifetime selectivity and activity, improved reliability and environmental benefits. Annual direct CO₂ emission reductions have been estimated by PETRONAS to be around 24,000 MT CO₂. Dow and PETRONAS Chemicals Glycols are working together with a third party to verify the results.

PETRONAS Chemicals Group Berhad views sustainability as a business imperative that complements the growth strategy by addressing environmental, social and governance concerns of various stakeholders, driven by balanced economic and business practices.

In support of Malaysia's goal of endorsing the Paris Agreement by reducing 45 percent of carbon emissions by 2030 in relation to Malaysia's 2005 GDP, PETRONAS Chemicals Group Berhad had initiated a proactive lead by striving to achieve the said reduction by at least 10 years prior to the targeted date. In fact, PETRONAS Chemicals Glycols' reduction of carbon dioxide emissions by 24,000 metric tonnes over the catalyst run length of 24 months is expected to significantly impact the Group's initiative. This reduction was attained through typical operational optimization of the process, which is also feasible to be leveraged by other various petrochemical plants. The major operating consideration is to obtain maximum catalyst performance throughout the run-length of the catalyst in accomplishing anticipated production goals.

PETRONAS Chemicals Glycols is the first carbon savings contributor to the Official Carbon Partnership between Dow and the International Olympic Committee. These emissions reductions, after third-party verification, will be used to mitigate a portion of the IOC's carbon footprint.

Dow-IOC official carbon partnership: combining the power of sport and science for a more sustainable future

Dow is a Worldwide Partner and the Official Chemistry Company of the Olympic Movement. In 2017, Dow was appointed the Official Carbon Partner of the International Olympic Committee (IOC) to develop carbon mitigation programs using science to create carbon savings that are applied to balance the operational carbon footprint of the IOC. Dow is collaborating with customers, value chain partners and industry leaders to work together to introduce innovative low-carbon technologies in the sectors of Buildings & Infrastructure, Food & Packaging and Manufacturing & Energy. These mitigation projects are tailored to the technology needs of the various geographic regions and help to accelerate the adoption of more sustainable technologies across different sectors and value chains. The program and carbon reductions are verified by a third party, Environmental Resources Management.

Be part of the program

As part of the Dow-IOC Carbon Partnership, we seek to deploy better technologies in industrial-scale chemical production that reduce costs and promote resource-efficient processes. We invite petrochemical industry leaders who would like to gain competitive differentiation, enhance sustainability expertise and be climate leaders to work with Dow and other technical experts to improve the economic and environmental efficiency of their production processes.

Learn more at <https://www.dow.com/en-us/sports/sustainability/ioc-carbon-partner>.



About Dow

Dow (NYSE: DOW) combines one of the broadest technology sets in the industry with asset integration, focused innovation and global scale to achieve profitable growth and become the most innovative, customer centric, inclusive and sustainable materials science company. Dow's portfolio of performance materials, industrial intermediates and plastics businesses delivers a broad range of differentiated science-based products and solutions for our customers in high-growth segments, such as packaging, infrastructure and consumer care. Dow operates 113 manufacturing sites in 31 countries and employs approximately 37,000 people. Dow delivered pro forma sales of approximately \$50 billion in 2018. References to Dow or the Company mean Dow Inc. and its subsidiaries. For more information, please visit www.dow.com or follow @DowNewsroom on Twitter.

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