



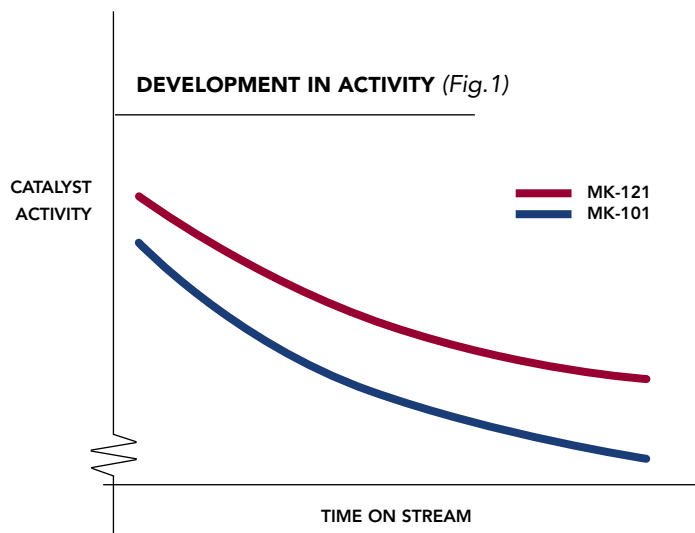
MK-121

High Activity Methanol Synthesis Catalyst





DEVELOPMENT IN ACTIVITY (Fig. 1)



Methanol Synthesis Catalyst

Topsøe's methanol synthesis catalyst **MK-121** is developed to match the requirements of methanol producers today in an increasingly competitive market place. Based on an optimised copper dispersion MK-121 ensures a better preservation of the initial high catalyst activity as well as an improved stability compared to its predecessor, MK-101, while at the same time attaining a remarkable selectivity. Furthermore, MK-121 offers a high flexibility in the operation allowing it to be used at a wide range of gas compositions.

The MK-121 offers:

- Longer useful catalyst lifetime
- Higher conversion and carbon efficiency during a prolonged service life
- Lower by-product level in the crude methanol
- Operational flexibility at the entire range of synthesis gas compositions

Increased Activity and Superior Selectivity

The initial activity of MK-121 is 10-15% higher than that of MK-101 (Fig. 1). The stability of MK-121 is higher, even at severe operating conditions. This means that the activity advantage is maintained throughout the catalyst lifetime, resulting in more methanol produced across the catalyst charge.

MK-121 demonstrates superior and stable selectivity, resulting in low by-product formation over the entire service life. Since the higher activity of MK-121 allows operation at lower temperatures, where conditions for by-product formation is less favourable, the total

level of by-products is typically reduced relative to that of the predecessor, MK-101 (Fig. 2).

Consequently, even higher methanol production is achievable, due to both the higher catalyst activity and to the reduction of product losses in the distillation section. Lower by-product formation also reduces refining operating costs.

MK-121 can be operated on synthesis gases originating from the entire range of feedstocks :

- Partial oxidation of coal, residues and other hydrocarbons
- Steam reforming of natural gas, LPG and naphtha
- Side-stream from the frontend of an ammonia plant

MK-121 ensures very high conversion efficiency whether the synthesis gas is rich in carbon monoxide, carbon dioxide or both.

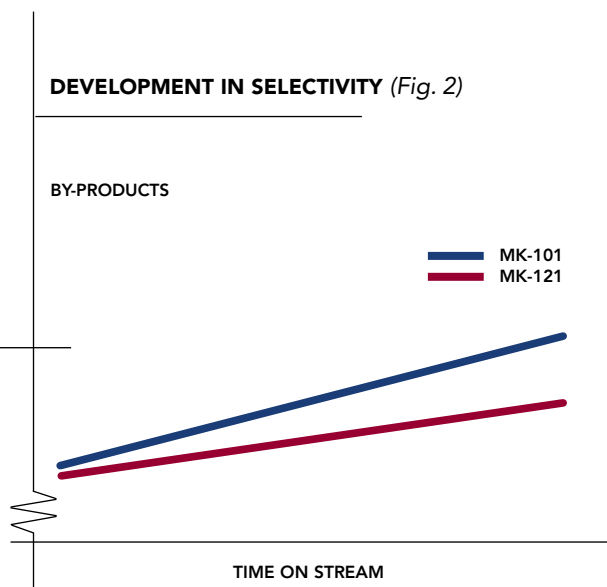
Tailor Made Solutions

Topsøe has a strong commitment to the methanol industry and offers tailor made solutions depending on requirement and fitted to the need of methanol producers. This has in fact resulted in design of a special methanol guard catalyst as well as development of new loading methods to improve the flow distribution.

Methanol Guard Catalyst

Most modern plants have efficient synthesis gas preparation sections where potential poisons are removed and poisoning of the methanol catalyst is negligible even after many years of operation.

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES FOR MK-121



	TABLET
CuO (WT %)	> 55
ZnO (WT %)	21-25
Al ₂ O ₃ (WT %)	8-10
GRAPHITE, CARBONATES, MOISTURE	Balance
STANDARD SIZE	6 x 4 mm / 1/4 x 5/32"
OPERATING TEMPERATURE	200-310°C / 390-590°F
NORMAL OPERATING PRESSURE	40-125 kg/cm ² g / 570-1775 psig

MK-121 has a high capacity for sulphur uptake and metal carbonyls and can in most cases completely guard itself against residual poisons.

However in cases with unusually high levels of sulphur and/or metal carbonyls or for cases where chlorine is present, Topsøe has developed a methanol guard catalyst. This unique catalyst will effectively pick-up sulphur, chloride and metal carbonyls at the prevailing operating conditions in the loop and will not form any by-products. The catalyst contains copper and thus has a modest but in practice insignificant activity for methanol formation. In fact the methanol formation is so low that the temperature rise across the guard catalyst is typically less than 5°C (9°F).

Catalyst Loading

The procedure used for catalyst loading is extremely important, as the catalyst performance depends heavily on even flow distribution. Therefore, the catalyst should be loaded as uniformly as possible to ensure that the catalyst is utilised efficiently.

Besides that, the catalyst should be packed as densely as possible in order to maximise the installed catalyst activity.

Topsøe has developed new loading methods, which increase loading density of the catalyst and improve the flow distribution through the catalyst bed(s) in various types of methanol converter designs. Furthermore, Topsøe is continuously studying existing loading procedures in order to develop new innovative techniques for installing catalyst.

Technical Service

Besides preparing tailor made solutions Topsøe provides on-site assistance and follow-up service according to the needs of the producer. A complete MK-121 catalyst operating manual including step-by-step procedures for storing, loading, activation and operation of MK-121 is supplied in connection with a catalyst purchase.

On-site Assistance

Topsøe offers on-site advisory assistance by experienced engineers for loading and reduction of MK-121. This service includes use of an on-line hydrogen analyser, which continuously and instantaneously measures the hydrogen content in the carrier gas throughout the reduction process.

Follow-up Service

Throughout the catalyst lifetime, Topsøe provides follow-up service in the form of regular performance evaluation of MK-121, including activity assessments and recommendations for possible adjustment of operating conditions to optimise the performance.

Regular evaluation of the catalyst will also enable Topsøe to accurately calculate the optimal time for catalyst replacement far in advance to help schedule the turnaround.

Should operating difficulties occur, Topsøe naturally provides on-site troubleshooting assistance. Topsøe also offers to analyse spent catalyst samples as well as crude methanol samples.

Topsøe R & D

Topsøe's worldwide services to the chemical, petrochemical and refining industries are based on a fundamental understanding of heterogeneous catalysis, including development and production of catalysts, process technologies and engineering services.

Quality catalysts – proven by performance

Topsøe's unique integrated approach has resulted in profitable solutions providing catalysts in the areas of:

- Feed Purification
- Adiabatic Steam Reforming
- Steam Reforming
- CO Shift Conversion
- Methanation
- Ammonia Synthesis
- **Methanol Synthesis**
- Formaldehyde
- Sulphuric Acid
- Refinery Hydroprocessing
- DeNO_x and DeSO_x
- Combustion of VOC

Based on many years of experience, the development of Topsøe catalysts is dedicated to provide a second-to-none performance. This means that focus always is on key factors such as enhancement of high and stable activity, long operating life, high resistance to poisoning, low pressure drop, energy savings and reduced emissions.

Customised after sales service

Topsøe's after sales service relies upon an on-going exchange of information between us and the client, to provide clients with relevant and most up-to-date information. The four pillars in Topsøe's service programme are: Frequent Contact and Discussions, On-site Supervision, Evaluation of Plant Performance and Troubleshooting.

Visit www.haldortopsøe.com for more information.

The information and recommendations have been prepared by Topsøe specialists having a thorough knowledge of catalysts. However, any operation instructions should be considered to be of a general nature and we cannot assume any liability for upsets or damage of the customers' plants or personnel. Nothing herein is to be construed as recommending any practice or any product in violation of any patent, law or regulation.

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