JM

Johnson Matthey
Inspiring science, enhancing life

JM ProcessWise webinar

An update on KATALCO 51-102 synthesis catalyst and developments for CO_2 to methanol

July 2021

Questions and answers

Please note that a number of similar and repeated questions have been combined.

Q1. Can we upgrade our catalyst from **KATALCO** 51-8 to **KATALCO** 51-102?

A1. Yes, but **KATALCO** 51-102 does cost more than 51-8 and not all potential applications may justify the premium. JM would evaluate the application and help understand the value **KATALCO** 51-102 would bring. In most cases, the extra value delivered would be far in excess of the extra price.

Q2. Is the new catalyst suitable for installation in all converter types?

A2. **KATALCO** 51-102 is designed to be compatible with the majority of converters in service at the moment. As part of evaluating your plant, any specific requirements of your converters will be considered.

Q3. How much longer might **KATALCO** 51-102 last than existing catalysts?

A3. It will depend on the plant set up and conditions. Please contact your JM representative who will be able to organise an evaluation of your plant.

Q4. What is the "prior generation" referred to in the slides?

A4. It refers to a non-Si promoted catalyst from the **KATALCO** 51-series. It represents the previously recommended premium product for the given duty.

Q5. From the operating references is there any changes to how the catalyst should be loaded and reduced compared to previous catalysts?

A5. No, the physical properties of KATALCO 51-102 are comparable to those for the prior generation of catalysts from the KATALCO 51-series. There are typically no changes required to plant operating procedures for catalyst handling, loading and reductions. For recommendations tailored to your plant conditions, please contact JM for further information.

Q6. Are the benefits the same in all plants and conditions?

A6. Individual plant set ups and conditions affect the deactivation of methanol synthesis catalysts and therefore the benefits achievable through improved stability. Please contact your JM representative who will be able to evaluate your application and explain how you can benefit from **KATALCO** 51-102.

Q7. Another impact on the methanol synthesis is from poisoning, is there any specific protection required against poisons?

A7. The small change to the formulation in **KATALCO** 51-102 has not impacted the resistance of the catalyst to poisons. The existing purification section of your plant should still be sufficient when operating with **KATALCO** 51-102 as long as it has the capacity to match the extended life of **KATALCO** 51-102. As part of evaluating your plant, JM will recommend suitable purification products.

Q8. When running your catalyst for CO2 to methanol do you start up in pure CO2 or in syngas?

A8. It can be started up in CO2+H2. Once the loop is stablished, the feed to the converter is a high CO2 syngas. Methanol synthesis is limited by equilibrium and therefore a recycle is always used. Moreover, because of the reverse water gas shift reaction CO will be formed and will be present at the feed to the converter, even for a plant fed with pure CO2 and H2.

Q9. In case of methanol synthesis from H2 and CO2, more H2O shall be generated in comparison with conventional Methanol process. **KATALCO** 51-102 catalyst can keep its performance even under the exposure to H2O?

A9. Catalysts from the **KATALCO** 51-series are already being used successfully in these applications. However, **KATALCO** 51-102 is an even more hydrothermally stable catalyst and will cope with even higher levels of water generated. Catalysts building from the same technical principles as **KATALCO** 51-102 are being specifically formulated for CO2 hydrogenation to methanol.

Q10. Which types of converter was commercialised **KATALCO** 51-102 references-USA Pampa. Which kind of client we can introduce this product? What is reasonable condition of **KATALCO** 51-102? What did you upgrade from previous catalyst to improve the production?

A10. The first references are in tube cooled and quench converters. The improved performance of **KATALCO** 51-102 is achieved via a tailored modification of the formulation, which now includes silica. The addition of silica has no significant impact on other important catalyst performance metrics such as selectivity, strength or attrition resistance, however, the effect on the stability of the catalyst over time is remarkable.

Q11. Will this addition of silica create more dust generations?

A11. No, the physical properties of **KATALCO** 51-102 are comparable to those for the prior generation of catalysts from the **KATALCO** 51-series. There are typically no changes required to plant operating procedures for catalyst handling, loading and reductions.

Q12. By High CO2 how much we mean? Is it zero CO?

A12. In the loop, it is a high CO2 syngas. Methanol synthesis is limited by equilibrium and therefore a recycle is essential to make the process economically feasible. Moreover, because of the reverse water gas shift reaction, CO will be formed and will be present at the feed to the converter, even for a plant fed with pure CO2 and H2.

Q13. Given potential temperature run away in methanol converters, how stable Silica would be in high water and high temperature situation should **KATALCO** 51-102 is used?

A13. The likelihood of silica leaching from the catalyst are extremely low, since the conditions at the methanol converter are far away of those required for this to happen. Moreover, the levels of silica have been extensively checked in discharged samples of **KATALCO** 51-102 operated under a range of conditions; none of the samples tested have shown indications of silica leaching

Q14. Effect of increasing CO2 content in syngas?, is there any max recommended?, same catalyst grade for high/pure CO2 (+H2) in syngas?

A14. Higher levels of CO2 will lead to higher levels of water being formed. **KATALCO** 51-102, containing Si as a stability promoter, is suitable and effective for this application even with a syngas of pure CO2 and H2.

Q15. On a m3/m3 base, how does the cost of 51-102 compare to 51-9S?

A15. KATALCO 51-102 does cost more than 51-9S and not all potential applications may justify the premium. JM would evaluate the application and help understand the value **KATALCO** 51-102 would bring. In most cases, the extra value delivered would be far in excess of the extra price.

Q16. From the operating references is there any changes to how the catalyst should be loaded and reduced compared to previous catalysts?

A.16 No, the physical properties of **KATALCO** 51-102 are comparable to those for the prior generation of catalysts from the **KATALCO** 51-series. There are

typically no changes required to plant operating procedures for catalyst handling, loading and reductions

Q17. Is **KATALCO** 51-102 suitable for steam raising converters?

A17. Yes, **KATALCO** 51-102 is suitable for steam raising converters. As part of evaluating your plant, any specific requirements of your converters will be considered

Q18. When running your catalyst for CO2 to methanol do you start up in pure CO2 or in syngas?

A18. It can be started up in CO2+H2. Once the loop is stablished, the feed to the converter is a high CO2 syngas. Methanol synthesis is limited by equilibrium and therefore a recycle is always used. Moreover, because of the reverse water gas shift reaction CO will be formed and will be present at the feed to the converter, even for a plant fed with pure CO2 and H2.

Q19. is there any potential for the silica added to 51-102 to end up in the reformed gas train leading to fouling of exchangers?

A19. The likelihood of silica leaching from the catalyst are extremely low, since the conditions at the methanol converter are far away of those required for this to happen. Moreover, the levels of silica have been extensively checked in discharged samples of **KATALCO** 51-102 operated under a range of conditions; none of the samples tested have shown indications of silica leaching