
Question 20: What are the allowable limits/guidelines for water in feed to hydroprocessing units? Does the guidance change for activation vs normal operation? If so, how? What effective test methods do you use to measure water in feed? Do the limits change for different hydroprocessing units?

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Tolerance for water is dependent on catalyst type and state. Prior to and during sulfiding and start of run cycle conditioning, hydrotreating catalysts can be quite vulnerable to water. Moisture will promote mobility of catalyst metals resulting in poorer metals dispersion and lower catalyst effectiveness. This can be particularly significant for many of the Type II formulations that feature loose association of metals with the catalyst support. In general, hydrotreating catalysts are very tolerant of even high levels of moisture after proper sulfiding and catalyst conditioning.

Hydrocracking catalysts are bifunctional, featuring both metal hydrogenation and solid acid cracking characteristics. Each function is susceptible to high levels of moisture. As with hydrotreating catalysts, metals mobility and agglomeration facilitated by higher levels of moisture are a concern. For noble metal hydrocracking catalysts, moisture has been limited to as low as 1.5 psi (0.1 kg/cm²) partial pressure. For base metals hydrocracking catalysts with moderate to high zeolite content, startup and operation at up to 20 psi (1.4 kg/cm²) water partial pressure has been successful. There are a variety of catalyst formulations so it is advisable to follow the procedures and limits specified by the catalyst provider. Incidentally, moisture, even at low concentration, is a key contributor to the initial steep increase in temperature requirement for zeolitic catalysts at start of run.

Particularly during unit startup and catalyst activation there are several potential sources of water. These may include moisture adsorbed on catalyst from the environment, water precursors in catalyst formulation, water generated from catalyst activation and vaporized process wash water as well as water associated with other process chemicals that may be introduced. So water is present in hydroprocessing catalyst systems. The key to success is to control the rate of release of water to a level acceptable for the system.

For conventional hydroprocessing operations it is generally recommended to avoid free (liquid) water in feed. But biofuels hydrotreating and renewables processing catalysts must remain robust in high moisture environments out of necessity since water is a prominent reaction product. And some resid hydrotreating catalysts function better upon introduction of water with the feed.

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