JM ProcessWise webinar

SPONGE METAL catalysts: handling, storage and safety

Q 01. What's the associated hazard risk with used SPONGE METAL™ catalyst, after the customer's reaction?

A 01. Used catalyst is often called "spent" catalyst. In most cases, spent catalysts are just as pyrophoric as fresh catalysts, and should be handled with the same caution. A protective liquid layer should be added to the spent catalyst and stored in sealed containers. The steel drums may be reused for shipping spent catalysts to the metal reclaimer (if permitted by local regulations).

Q 02. Can you reclaim the waste in the process?

A 02. Yes; The nickel contained in the spent catalyst is a valuable natural resource and can be reclaimed. Johnson Matthey can offer assistance.

Q 03. What's the best storage condition temperatures?

A 03. Drums should be kept in a cool, dry place under reasonable conditions (not exposed to the elements of weather and extremes of temperatures – ideally kept between 5 - 30°C). We recommend storing the drum in a separate area as flammable solvents or vapors.

Q 04. What packaging options are available?

A 04. Product packaging can be customized. Packaging options provide many benefits to production plant operators, warehouse personnel, health and safety professionals, and supply chain managers. **SPONGE METAL** catalysts standard packaging (Gross volume).

- 55 US gal / 210.8L
- 30 US gal / 114L
- 16 US gal / 60.5L
- 5 US gal / 18.9L

Q 05. What type of steel drum is used for shipping?

A 05. All **SPONGE METAL** catalysts are shipped in a UN Liquid/Solid rated steel drums.

Q 06. What type of auxiliary safety equipment is recommended when using SPONGE METAL catalysts?

A 06. Eye-washing stations; Emergency showers; Fire-extinguishing equipment; Class D fire extinguishers only

Q 07. **How do you remove spent catalyst from a filter?**

A 07. The filter cake should be thoroughly washed to remove organic solvents and place into suitable drums. Cover the surface of the spent catalyst with an excess of water. Label drum correctly and reseal properly.

Q 08. **Can you please comment on the best practice for loading and unloading catalyst from a trickle-bed column reactor?**

A 08. Typical Sponge hydrogenation reactions are conducted in batch, semi-continuous or continuous using a CSTR (Continuous Stirred Reactor). Recent advances have allowed sponge nickel slurry catalysts to be used for trickle bed reactor laboratory testing, such as the HEL FlowCAT. The first step is ensuring the catalyst slurry is well mixed and add it to the reactor using a plastic pipette. Excess water should be added to allow a protective layer and to ensure the catalyst is always wet. Allow the catalyst to settle before adding inert packing, such as glass beads, to cover the empty space of the reactor when necessary, not letting the catalyst dry out. Place the reactor column in the system ensuring all connections are tightened. After the reaction has been completed, unloading the reactor column will generally occur in the reverse order, using excess water to transfer the Sponge catalyst slurry to an appropriate container. Please contact JMT technical staff for additional assistance.

Q 09. **What is sponge nickel used for when handed over to metal recovery units/companies? Electroplating?**

A 09. The end use for reclaimed Sponge Nickel catalyst is typically within the steel industry.

Q 10. **There was a recent OPRD article on the use of Sodium Nitrate to deactivate Raney-Co (https://pubs.acs.org/doi/abs/10.1021/acs.oprd.0c00053). Is it something you tried and/or would recommend?**

A 10. Yes, we have experience with using sodium nitrate deactivation procedure Previous experience at JMT lab has shown sodium nitrate, $NaNO_3$, as a good oxidizer to dramatically drastic effect on the catalyst activity. The nitrate ions (NO_3-) ions are hydrogen scavengers that extract the surface hydrogen on the Sponge Ni catalyst and produce ammonia gas (NH_3). Additionally, the excess NO_3- ions may also attach to the active nickel sites and oxidizing the surface nickel. The oxidization of the surface reduces or eliminates the pyrophoric nature sponge catalyst.

Q 11. **How can I test that my catalyst is deactivated?**

A 11. The process for testing a possible deactivated catalyst should be addressed with the JM technical staff for best practice prior to trying a method to ensure the proper method is used. JM's lab can also test for the catalyst deactivation properties in Sevierville, TN.

Q 12. **When filtering the catalyst under nitrogen to recycle for the next batch would you flush the catalyst off the filter with organic feed or water for the next reaction or both in turn?**

A 12. We recommend washing the catalyst with water or other appropriate solvent (i.e. methanol). It can remove some organics from the catalyst surface and increase lifetime.

Q 13. **Does JM have any data to share on cat. activity vs time?**

A 13. Yes, please contact JM Sponge technical team for additional information.

Q 14. **Is it typical to use filter aids to filter the catalyst at large scale filtration systems?**

A 14. If a filter precoat or filter aid is required, then we recommend using a cellulose filter aid, that has a low silica content and fully combustible. A diatomaceous earth, or diatomite filter aid has a high silica content and lowers the reclaim value of the spent nickel. Please inquire for the specific reclamation needs.

Q 15. **Does the catalyst physically break down in the process if it's agitated? If so, does it lose activity?**

A 15. Under a typical hydrogenation process using overhead agitation, sponge catalyst attrition is very minimal. Some reaction system, such as a high flow Loop Reactor, may experience additional attrition due to high flow velocity pumps. If this occurs, increased fines will affect the filtration system. Catalyst oxidation can alos cause significant particle size attrition.

Q 16. **Do you offer PDH credits?**

A 16. Unfortunately, we are not accredited for continuing education credits so unable to offer PDH credits for the webinar. We can, however, a Certificate of Attendance upon request.

Q 17. **What is the best filling quantity? Our sugar concentration is 50%**

A 17. The initial catalyst loading weight is typically around 3 -5 % of the anhydrous dextrose (sugar) weight. Since the catalyst has a gradual decline in activity after each batch, some small amount of fresh catalyst is usually added to every batch or every 2-3 batches. The amount of such "make-up" catalyst is usually on the order of 0.5-1.5% or more of the original full charge amount.

Q 18. **How to confirm the catalyst deactivated after bleach treatment?**

A 18. The catalyst's pyrophoric properties can be tested by allowing a small portion of catalyst to dry on a piece of filter paper. If the catalyst heats up upon drying, then the deactivation procedure should be repeated. This procedure should only be conducted using proper PPE and within a controlled environment. Once the catalyst is no longer pyrophoric, it should be filtered from the slurry and if possible, allowed to remain wet. If the deactivated catalyst must be dried, then do so under conditions that prevent it from becoming airborne.

Q 19. **During the filtration the catalyst is already dry but how to take care of this operation? Since it is pyrophoric while it is dry then potential dangerous associated handling it with organic solvent.**

A 19. The filter cake should be thoroughly washed with water to remove organic solvents and place into suitable drums. Cover the surface of the spent catalyst with an excess of water that prevent the nickel particles becoming airborne.

We at JM would like to thank you for participating in this webinar.