A World Leader in Industrial Ceramic Products

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Hold Down Alternatives For Secondary Reformers

The top of the Secondary Reformer is the hottest part of the unit, leaving it prone to silica leaching and corrosion of metal oxides in refractory materials. Hold down media used in this section to protect the catalyst is susceptible to churning or even uplifting during operation. Such issues, in addition to exposing the catalyst underneath, can also lead to channeling and erosion of the media, and potentially a premature shutdown.
There are several hold-down media options for this application. Their advantages and weaknesses are described below.

1. **2'' (50 MM) or 3'' (76 MM) T-99 or T-46 PROX-SVERS®, Alumina Support Balls**
   Large alumina support media, made from high alumina materials with a very low silica content serve as an effective hold down media with a predictable pressure drop. They are easy to install, and the large size and mass increases their resistance to movement as compared with smaller support balls. A layer of 1'' (25 mm) balls are usually placed below the larger balls and directly on top of the catalyst.

2. **HT-99 Custom Crafted ™ Hexagonal Target Tile**
   Christy's specialty product for this application is the Hex Tile. They are the best option to prevent milling or churning in the Secondary Reformer, and at any available thickness will provide a lower pressure drop over balls. Christy's Hex Tiles are optimized for abrasion resistance and the HT-99 mix contains 99% alumina with an ultra-low silica content. The largest size available, the Super Jumbo, is 3.5" (88.9 mm) thick, weighs approximately 49 lbs (22.2 kg), and is virtually immovable when installed, yet designed to fit through any typical vessel manway. In addition to Super Jumbo, Christy offers two other general sizes, Standard and Jumbo, which have thicknesses of 2" (50 mm) and 2.5" (64 mm) respectively, with significantly different footprints and weights. A solid 6" (152 mm) thick Jumbo tile is also available for the option of installing a target area directly beneath the burner to help better distribute the gas process stream or prevent flame impingement.

   Customers select the tile based on the velocity in the vessel, the distance between the burner and the bed, and consideration of any problems that they have experienced in the past.

3. **HT-LC Low Corrosion Hex Tiles and PROX-SVERS**
   Christy's HT-LC Low Corrosion mix is a proprietary, low corrosion metal oxide formulation, developed to resolve issues of high temperature corrosion of alumina and soda, in Secondary Reformers and ATRs who have experienced such problems. HT-LC Hex Tiles are available in the same sizes and configurations as HT-99 Hex Tiles, and HT-LC PROX-SVERS area available as 1.5" (38 mm), 2" (50 mm), and 3" (76 mm) balls.

4. **Alumina Lumps**
   Alumina lumps are another hold down media alternative. The only advantage that alumina lumps may have over other hold down options is cost. However, they have several disadvantages as follows:

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- Delivery – The larger sizes required for Secondary Reformers in the Syngas Industry are not readily available. Generally, longer lead times are associated with this product.
- Pressure drop - The irregular size results in a greater pressure drop than that of balls due to their lack of aerodynamic properties and the tortuous pass which the gas stream must take around the packed lumps.
- Inconsistent Packing Density - The very nature of the irregular lump results in inconsistent packing density. Lumps are made by melting alumina in an electric arc furnace and then casting the molten material onto the floor. This material is then shattered much like a glass would shatter resulting in irregular shards which can be very long and narrow. These shards can then penetrate down into the catalyst bed resulting in channeling.
- Volume Required - Because of the issues outlined above, typical installations call for at least 12” (305 mm) bed depth, which is significantly thicker than required with other media.

Other Commercial Products

Other vendors have offered catalyst carrier type materials for the tops of the beds, but these do not offer any advantage over regular 2’’ or 3’’ alumina PROX-SVERS. Often, they are lighter and are more easily displaced as well as being more expensive. In addition, as the catalyst in the secondary lasts for an extended period of time, these materials do not hold up as well as a 99% alumina Hexagonal Target Tile.

Required Volume

2" (50 mm) or 3” (76 mm) PROX-SVERS require a minimum bed thickness of 6” (152 mm) or 9” (229 mm) respectively (equating to 3 times the diameter of the ball) . Alumina lumps require a minimum bed thickness of 12" (305 mm). Beds comprised of Hexagonal Target Tile vary between 2.0” (50 mm) and 3.5” (89 mm) depending upon the tile selected, although the trend is towards the Super Jumbo tile. For plants which have experienced bed churning or erosion issues directly beneath the burner, a small area of 6” (152 mm) thick, solid tile can be used.

Pressure Drop

Based on conversations with catalyst vendors and engineering design personnel, the consensus is that alumina lumps have by far the highest pressure drop due to their irregular shape, poor aerodynamic properties and thicker bed volume required. 2" (50 mm) and 3” (76 mm) PROX-SVERS have significantly less due to their round surface, consistent void volume and reduced volume required for loading. 3” (76 mm) PROX-SVERS have around 30% less dP than 2" (50 mm). Hexagonal tile is a little more difficult to measure, but bench scale testing indicates that 2.5 (64 mm) " thick Jumbo Hexagonal Target Tile with 3/4" (19mm) holes have about half the dP of 3" (76 mm) diameter balls.

Data sheets and additional technical information on PROX-SVERS, Hexagonal Target Tile, and alumina lumps are all available upon request from Christy Catalytics, LLC.

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