

Catalyst Hold Down Alternatives For Synthesis Gas Secondary and Autothermal Reformers

There are several ways to provide a target or catalyst hold down in synthesis gas reformers (secondary / autothermal). These same methods also hold true for an HTS.

1. **2" or 3" T-46 or T-99 PROX-SVERS® Alumina Balls**
3" diameter high alumina balls provide two advantages over 2" diameter balls:
 - a) Greater mass and thus are less likely to be moved by the process stream.
 - b) Lower pressure drop across the bed.

2. **Custom Crafted™ Hexagonal Target Tile**
Hexagonal Target Tiles are the material of choice for synthesis gas reformers specified by process designers such as KBR and Haldor Topsoe. Target tile are more time consuming from an installation standpoint, but are the least likely product to mill or be displaced. Christy offers several sizes ranging from the original 2" thick Standard (3.6 pounds) up to the 3.5" Super Jumbo (49 pounds). In addition, solid 6" thick tile is available for the target area directly beneath the burner to help better distribute the process gas stream.

Christy's Hex Tile are manufactured from high purity, low silica, abrasion resistant 99% alumina material.

3. **Alumina Lumps**
Christy also offers white fused alumina lumps. The only advantage of lumps over any of the other options is cost. The disadvantages of lumps are:
 - a) Delivery – Availability of the 2" x 4" and 4" x 8" large sizes desired for synthesis gas reformers is very limited and results in extensive lead-time.
 - b) Pressure drop - The irregular size of alumina lumps results in a greater pressure drop than that of balls due to their lack of "aerodynamic" properties and the tortuous path which the gas stream must take around the packed lumps.
 - c) 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 cause channeling of the bed as they penetrate down into the catalyst bed.
 - d) Volume Required - Typical installations call for at least one foot of bed depth, which is significantly thicker than alumina balls or hexagonal target tile.

4. **Low dP PROX-SVERS**

Christy Catalytics has introduced a new variation of large diameter PROX-SVERS alumina balls designed to significantly reduce the pressure drop of fixed beds such as those found in synthesis gas reformers. This product is available in the T-46 (low silica) chemistry in 1.5", 2" and 3" diameters. Pilot plant tests indicate that this product reduces the pressure drop by approximately 33% when compared to an equivalent diameter inert support ball.

5. **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 T-99 or T-46 2" and 3" alumina balls. Often, these alternative commercial products are lighter and are more easily displaced as well as being more expensive. In addition, as the catalyst in the synthesis gas reformer lasts for an extended period of time, these materials do not hold up as well as the 99% Hexagonal Target Tile or Alumina Balls.

Required Volume

2" alumina balls require a minimum bed thickness of 6 inches (3 diameters) and 9" is preferred. Alumina lumps require a minimum bed thickness of 12". Beds comprised of Hexagonal Target Tile vary between 2.0 inches and 6.0 inches depending upon the tile selected, although the trend is towards the larger 3.5" thick Super Jumbo tile. For plants which have experienced bed churning or erosion issues directly beneath the burner, a small area of 6" 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" and 3" alumina balls have significantly less pressure drop due to their round surface, consistent void volume and reduced volume required for loading. 3" alumina balls have around 30% less dP than 2". Hexagonal tile is a little more difficult, but bench scale testing indicates that 2.5" thick Jumbo Hexagonal Target Tile with 3/4" holes has about half the dP of 3" diameter balls. The consensus from personnel which this has been discussed with is that lumps are the worst choice for dP, followed by 2" alumina balls, Low dP 2" alumina balls, 3", Low dP 3" and finally hextile with 3/4" holes.

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