

## Editorial Tech Brief

High Performance Catalyst Solution for  
Steam Reforming Hydrogen Plants

### Catacel's Stackable Structural Reactor (SSR®) Technology Yields Immediate 13.5% Decrease in Natural Gas Fuel Burner Consumption For North American Hydrogen Plant

#### Customer

Major North American Hydrogen Facility, Guadalajara, Mexico producing hydrogen to support food ingredients manufacturing

#### Catalyst Solution

Catacel's SSR® metal foil structured catalyst for steam methane reforming

#### Benefits

Immediate 13.5% natural gas burner fuel cost reduction, fast ROI

#### CUSTOMER UNMET NEED

The plant operator wanted to obtain natural gas savings in burner consumption to have the option to increase throughput beyond the 100% plant rate and longer operational time life for catalysts and reforming tubes. The reformer configuration was very typical for a food ingredients facility, consisting of reformer tubes of varying ages, several of which had been recharged with ceramic pellet catalyst as recently as January 2012.

#### SOLUTION

After a thorough study and analysis, the plant operator made the decision to replace the ceramic catalyst media in all reformer tubes with Catacel's SSR® steam methane reforming structured catalysts (Figure 1). The install was completed with minimal downtime in May 2012 by plant staff supervised by Catacel. Ease of the install is shown in Figures 2, 3 and 4.

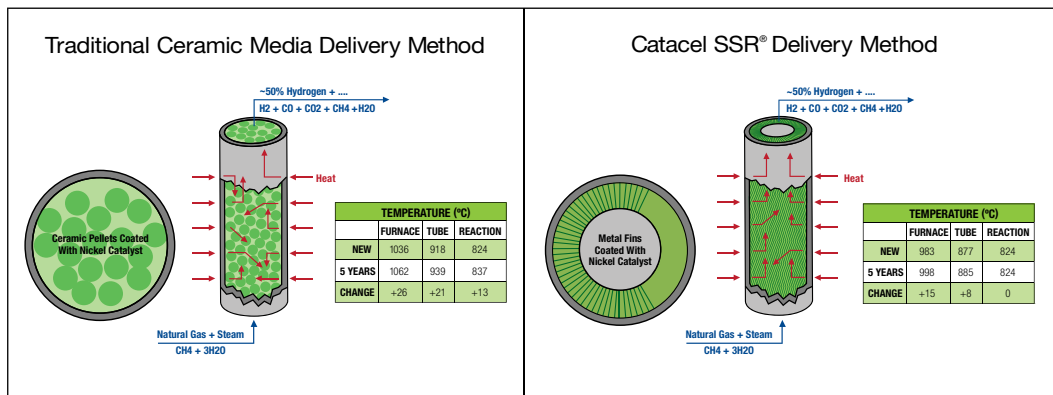


Figure 1 – Catacel SSR® catalyst coated metal foil unit.



Figures 2,3,4 – The easy install was completed in two days by plant staff supervised by Catacel.

Catacel's approach to improving overall system performance combines proprietary high performance catalysts with foil substrates designed to deliver superior heat transfer and increased surface area. In combining these two functions, the catalyst is put on custom designed, high surface area formed metal foil, which also serves as heat transfer media. The fins in each SSR<sup>®</sup> unit are arranged for superior heat transfer that enables the use of lower furnace temperatures with consequent overall system energy savings and extended tube and furnace life. *Figure 5* illustrates heat transfer inside a reformer tube with both traditional ceramic media and also with the Catacel SSR delivery method.



*Figure 5 – Heat transfer illustrated inside a reformer tube with traditional ceramic media and also the Catacel delivery method.*

The catalytic surface area is about 2.5 times greater than possible with ceramic media. The higher surface area also ensures that more active ingredient is available to the reaction.

Installation of the SSR<sup>®</sup> catalyst coated formed metal foil units was done in 3-ft. long sections with tools designed by Catacel to slide the media down from the tube top (*Figure 6*). Once inserted, the special tool was used to expand the metal foil to conform to the internal geometry of each tube. This installation required 72 sections made from a total of 1,912 SSR structures that were installed over two days.



*Figure 6 – Installation of SSR catalyst was done in 3-ft. long sections with tools designed by Catacel by sliding the media down from the tube top.*

## **SUCCESS FACTORS**

Initial reporting at 100% plant rate with the Catacel SSR® indicated a 13.5% reduction in natural gas consumption by the reformer burners over the nominal values of previous months and years of operation. Furthermore, by reducing the reformer furnace fuel feed, and consequently temperature at which the tubes are operated, it is projected that reformer tube life can be expected beyond design life.

With the ceramic catalyst, the plant was operating at 100% rate at furnace temperatures ranging from 885 to 916°C, with process reaction temperatures in the 800-815°C range. With the Catacel SSR® catalyst coated metal foil inserts, the plant now runs at 100% rate at a furnace temperature of 859°C – a decrease of 26 to 57°C with similar reaction temperatures and no reduction to product capacity or quality. The tubes appear to be running much cooler, indicating that they were enjoying the benefit of lower furnace temperature. Based on current NG pricing in Mexico, ROI for the Catacel system based only on fuel savings is expected to be within 2.1 years.

## **CUSTOMER GAINED VALUES**

In addition to the impressive natural gas fuel savings, the SSR® catalyst system will not fracture, clump together and create space voids, or increase tube pressure drop over time, as is typical for ceramic pellets. In addition, SSR's increased geometric surface area is expected to allow the SSR® media to perform for the life of each tube.

Catalyst media can have a large effect on the furnace and tube temperatures that are needed to achieve the required reaction temperature. Ceramic media, with modest heat transfer capability, typically operates with a 90°C to 100°C temperature differential between media and tube. SSR® media, with significantly better heat transfer capability, decreases that differential by 35°C or more. This allows the tubes to operate cooler, extending tube life.

