

# Process Technology that Saves on Fuel and Improves Performance

## Catacel's Stackable Structural Reactor

### A Process Technology Update from Catacel

For nearly a century, catalyst-impregnated ceramic pellet media has driven Steam Methane Reforming (SMR) reactions in hydrogen plants. Catacel Corporation of Garrettsville, Ohio ([catacel.com](http://catacel.com)) has tested and perfected a new higher performance alternative—the Stackable Structural Reactor (SSR®). This precision engineered, catalyst-coated metal foil reactor, which replaces traditional ceramic media in steam reforming hydrogen plants, provides 30 percent improved heat transfer; 2.5 times more catalytic surface area; and is “break” and “crush” resistant—two constant failure modes associated with ceramic pellet media. (See “*New Long Life Replacement Catalyst for Steam Reforming Hydrogen*,” *Catacel Report, CryoGas, April 2010, p. 44.*)

CPIngredientes, the first and only high-fructose corn syrup manufacturer in Mexico, has a hydrogen facility in Guadalajara, Mex-

ico that serves that country, Central America, and the Caribbean markets, and has exports reaching more than 25 countries. To improve overall performance and profitability at the plant, CPIngredientes sought to obtain natural gas savings in burner consumption, have the option to increase throughput beyond the 100 percent plant rate, and attain a longer operational lifetime for catalysts and reforming tubes. The reformer configuration at the plant consisted of reformer tubes of varying ages, several of which had been recharged with ceramic pellet catalyst as recently as January 2012. After thorough study and analysis, plant management decided to replace the ceramic catalyst media in all reformer tubes with Catacel Stackable Structural Reactor steam methane reforming structured catalysts. The changeout was completed with minimal downtime in May 2012 by plant staff supervised by Catacel.



Catacel SSR® catalyst coated metal foil unit, top view

Catacel's changeout to a foil-supported, heat exchanging steam methane reforming catalyst at the Guadalajara plant in May 2012 resulted in a decrease of up to 30 percent in natural gas consumption by the reformer burner, and a corresponding increase in plant efficiency.

Catacel's approach to improving plant efficiency and performance involves coating proprietary high-performance catalyst onto engineered foil supports (“fans”) designed to deliver superior heat transfer at the same or lower pressure drop than traditional ceramic pellet catalysts. SSR's increased heat transfer coefficient enables the operator to reduce furnace temperatures with consequent overall energy savings and extended tube and furnace life.

Catalyst media have a large effect on the furnace and tube temperatures that are needed to achieve the required reaction temperature in a hydrogen plant. Ceramic media 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 at cooler temperatures and extends tube life. In addition, the SSR fans are engineered to provide a reactive surface area that is about 2.5 times greater than typical of ceramic media. The higher surface area serves to ensure that more active ingredient is available to the reaction, and predictably to a longer catalyst life.

Installation of the SSR catalyst was accomplished in three-foot long sections of fans delivered to the plant site and inserted into the reformer tubes with tools designed by



The changeout/installation of SSR catalysts was completed by CPIngredientes plant staff and supervised by Catacel.

## SSR vs. Ceramic Pellets from Plant Log

Plant Rate	%	Ceramic Pellet Catalyst			Catacel SSR		
		50%	60%	100%	50%	60%	100%
Steam to catalyst	Kg/Hr	530	584	944	521	592	973
Gas to burner	NCMH	92	94	104	74	67	90
Gas to process	NCMH	136	163	272	136	163	272
Hydrogen production	NCMH	365	448	696	383	420	701
Reformer Temp	°C	913	913	894	870	837	859

Figure 1

Catacel Corporation

Catacel. Once inserted into place, each section of SSR was expanded to conform the individual SSR fans to the specific internal geometry of each tube. This installation required 72 sections comprising a total of nearly 2,000 SSR fans, which were installed over a two-day period.

### Success Factors

Initial reporting at a 100 percent plant rate with the Catacel SSR indicated a 13.5 percent reduction in natural gas consumption by the reformer burners over the nominal values of previous months and years of operation.

However, readings taken in subsequent months and at various plant rates, demonstrate burner fuel reductions of up to 30 percent (see Figure 1), consequent reduction to reformer temperature, as well as improvement to overall plant efficiency. Based on cur-

rent natural gas pricing in Mexico, ROI (return on investment) for the entire Catacel SSR change—based only on fuel savings—is within 2.1 years.

### Customer Gained Values

In addition to providing ongoing natural gas fuel savings, the SSR® catalyst system does not fracture, clump together, create space voids, or increase tube pressure drop over time, as is typical for ceramic pellets. In summary, SSR technology is expected to allow the catalyst to extend the life of reformer tubes and remain active over the extended tube life.

For more information on Catacel SSR visit [www.catacel.com](http://www.catacel.com).



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