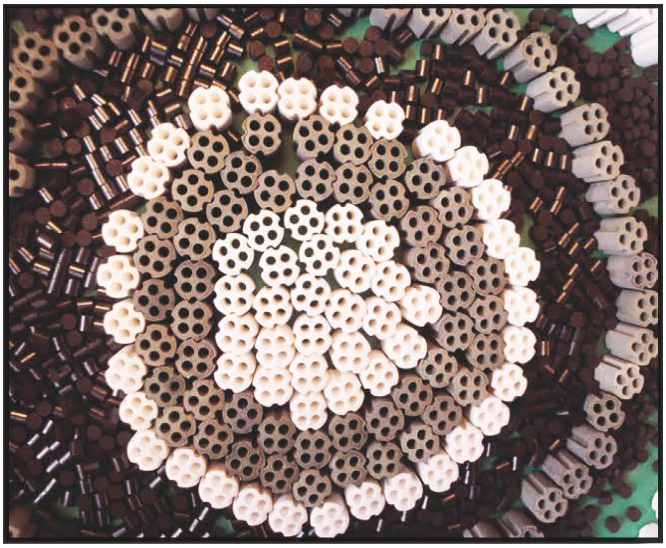
HiFUEL® Base Metal Reformer Catalysts

Johnson Matthey is a world leading developer of catalysts and processes for hydrogen generation from a range of feedstocks. The HiFUEL® catalyst range is designed specifically for distributed hydrogen generation systems and includes both base metal and precious metal formulations.



Fuel cells are being developed for a range of stationary, mobile and portable power generation applications. Fuel processors generate a hydrogen rich reformate feed for the fuel cell from readily available hydrocarbons such as natural gas, LPG, methanol and gasoline. This can be achieved by reacting the fuel with steam (Steam Reforming), air (Partial Oxidation) or a combination of the two (Autothermal reforming).

The reformate stream contains contaminants such as trace hydrocarbons, sulfur compounds and carbon monoxide, which can be detrimental to the performance and lifetime of the fuel cell. The amount of gas clean-up needed depends on the fuel cell type, with high temperature fuel cells requiring less pre-processing than low temperature fuel cells.

Hydrogen is formed via the steam reforming reaction when saturated hydrocarbons react with steam to form carbon monoxide (CO) and hydrogen (H_2). The water gas shift reaction also takes place as CO and water react to form carbon dioxide (CO_2) and additional hydrogen. Although the water gas shift reaction is strongly exothermic, the reforming reaction is strongly endothermic, resulting in an overall endothermic process. This means that heat must be added to the system to allow the reaction to approach equilibrium.

HiFUEL® R110 is ideal for low molecular weight, saturated gaseous hydrocarbon streams allowing for some feedstock flexibility with minimal carbon deposition. The Quadralobe™ shape results in a high-surface area pellet with excellent strength and packing characteristics.

HiFUEL® R120 is a copper based methanol reforming catalyst supplied in mini-pellet design offering outstanding strength and packing characteristics for compact fuel processor system designs.

Item	Description	Operating Temperature	Application
45465	Nickel based steam reforming catalyst, HiFUEL® R110	550°C-900°C	Natural Gas / LPG
45468	Copper based methanol reforming catalyst, HiFUEL® R120	200°C-350°C	Methanol

Available in 500g, 1kg, 2.5kg sizes. Bulk quantities also available on request.

HiFUEL® Base Metal Reformer Catalysts

Catalyst	Physical Properties	Temperature	Pressure	Steam ratio	Catalyst Loading
45465 (HiFUEL® R110)	Shape: Quadralobe, 4 hole, 4 flute domed cylinder Size: 10.5mm x 13mm Loaded density: 900kg/m^3	Recommended: 900°C Outlet defines approach to equilibrium (850-900°C for near equilibrium operation) Minimum:550°C Maximum:900°C	Minimal effect on approach to equilibrium	Steam-to-carbon less carbon oxides: 2.2 to 7.0 As the C_2^+ content of the feed increases above 3mol%, the steam-to-carbon ratio should be increased to >4.	GHSV < 5000hr-1
45468 (HiFUEL® R120)	Shape: Cylindrical pellet Size: 5.2mm x 3.0mm Loaded density: 1400kg/m^3	Recommended: 200-350°C Minimum:200°C Maximum:350°C Temperature of feed gas should be at least 20°C above dew point.		>1	

Catalyst	Feed Quality	Activation	Handling	Disposal
45465 (HiFUEL® R110)	Appropriate for feeds as heavy as LPG. The CO_2 content of the feed should be less than 5mol%, the steam-to-carbon-ratio should be increased to >4. Susceptible to poisons such as sulfur, chloride, metals and silica. An upstream desulfurisation step is recommended that reduces sulfur to <0.5ppm. Steaming under full steam or steam-to-carbon 7.0 at 740°C can often remove low levels of poisons, as well as carbon, restoring catalyst activity.	Supplied in non-reduced form. An activation step is required. The catalyst should be reduced by exposure to dry hydrogen for at least 2 hours at 600°C.	Once reduced, the catalyst is pyrophoric. Prior to discharge, the catalyst should be exposed to steam and oxidised. Avoid contact with skin and clothes. Avoid breathing dust. Do not take internally. Consult the relevant safety data sheet for further information.	Oxidation is required prior to disposal. Dispose according to local guidelines; refer to SDS.
45468 (HiFUEL® R120)	Susceptible to sulfur, chloride, silica poisoning and higher hydrocarbons; upstream purification required to protect from these components.	Supplied in non-reduced form. A controlled activation is required under reducing conditions, and above the dewpoint. The reducing agent concentration should be less than 2%mol dry, and the temperature should be maintained at <230°C.		

Johnson Matthey offers a complimentary range of precious metal fuel processing catalysts that have been developed specifically for fuel cell applications. For more information contact HiFUEL.coatedcatalysts@matthey.com.