"It's getting harder for me to meet my hydrogen or syngas production demand."

Using too little steam for the amount of carbon in the feed gas reduces catalyst life and the overall plant production level, and can lead to a plant shutdown, which is an extremely costly consequence.

Coriolis flowmeters improve hydrogen production, Hydrocarbon Processing, August 2007

What if…

- You could **maintain the proper steam to carbon ratio** even with changing natural gas composition?
- You could **improve your catalyst life**?
- You could **reduce methane slip** in your process?

How are you ensuring consistent hydrogen or syngas production at high levels?

You are under a lot of pressure to produce hydrogen or syngas as efficiently as possible from the steam methane reformer. Downstream processes rely on consistent production and unplanned shutdowns are to be avoided at all expense.

Controlling the steam to carbon ratio in the reformer reactor can be a challenge when the fuel (natural gas or refinery fuel gas) changes composition. Insufficient steam can cause reduced hydrogen output and excessive coking, leading to plant shutdown. On the other hand, too much steam reduces both the thermal efficiency of the plant and the amount of export steam, increasing operational costs and energy consumption.

Knowing the full composition is the first step in controlling the steam to carbon ratio. In order to do this, you must take additional measures and install extra equipment, which may lead to additional maintenance headaches.

Process Engineers we talk to tell us about challenges like these:

"We don't have a good way to deal with variability in feedstocks."

You're asked to keep the steam methane reformer running at its optimal condition and obtain the correct steam to carbon ratio. The problem is, you either don't have any visibility to changes in composition of the hydrocarbon stream, or you are using a gas chromatograph that doesn't tell you about composition change quickly enough to react.

"Other processes rely on the supply of hydrogen or syngas."

If the steam methane reformer goes down, there is a ripple effect throughout the plant. You need to be sure that the process is running effectively and the catalyst life is extended as much as possible.

"I need more ways to reduce methane slip."

You're restricted in terms of changing reformer outlet temperature and catalyst, but you still need to do your part in reducing the methane slip. In syngas production for ammonia synthesis, if methane infiltrates the ammonia process, it can adversely affect the rate of reaction.

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Process Management

STEAM METHANE REFORMING

The steam to carbon (S/C) ratio is a critical control point in your process. Traditional measurement, such as a dP meter (orifice plate) combined with a gas chromatograph (GC) is expensive, and the GC can be maintenance intensive. It may take up to 15 minutes to get the information from the GC to calculate the carbon mole weight.

Using a Micro Motion 3098 Specific Gravity Meter virtually eliminates the maintenance costs and allows for updates in seconds. The meter can output molecular weight (within 0.1%), which can be used to calculate the carbon content of the stream. It can be used in conjunction with a Micro Motion mass flowmeter to further improve S/C ratio control.

An alternative is to use a Rosemount Vortex meter for steam measurement and a Micro Motion ELITE® flowmeter to measure the mass of hydrocarbon stream and assume an average carbon content. The Coriolis flowmeter will have better accuracy (+/-0.25% of mass flow) than a typical dP device and even with composition variations, S/C ratios can typically be controlled within 0.1 point if the inert gases are fairly constant. This is possible because the S/C ratio is actually based on the number of carbon moles, which are proportional to the mass flow.

An industrial gas company was able to improve their ability to control the steam to carbon ratio by 10 times by replacing an orifice plate and gas chromatograph with a Micro Motion ELITE sensor and a fixed molecular weight value. Efficiency increased by as much as 8 BTU/SCF of hydrogen produced.

REDUCE IMPACT OF FEEDSTOCK VARIABILITY

With faster visibility to changes in molecular weight (related to carbon content), feed rates can be changed to maintain better control of S/C ratio and prevent the tendency to run at a higher ratio than necessary. Another alternative is to use a flow metering technology that is inherently more immune to changes in composition than traditional volumetric flow meters. This means changing the feed composition will have less of an impact, allowing for a more efficient operation.

IMPROVE THROUGHPUT AND UPTIME

With better S/C ratio control, you can reduce the risk of running your process with too little steam and potentially depositing carbon on the catalyst, reducing catalyst life and increasing shutdowns. Downstream processes will not have to worry about feedstock supply.

REDUCE METHANE SLIP

You can reduce the amount of methane slip in the process by adjusting S/C ratios to get the reaction to approach equilibrium.

www.MicroMotion.com/Gas

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