# Maximizing the potential of gasification facilities

## Simple solutions, huge benefits

Here and now gasification plants have the functionality to make the hydrogen economy a real possibility. Greatly reducing the cost of hydrogen production by using renewable resources and advanced, reliable processing techniques enables a gasification plant to produce valuable hydrogen product from waste materials.

While the technology is available to enable this functionality, however, most plants opt to simply create SynGas, a mixture of hydrogen and carbon monoxide. However, as market demand for hydrogen increases in parallel with the stationary and transportation fuel cell industry, gasification facilities will likely be the top producer of renewable hydrogen fuel – mostly due to the low cost of production and the scalability of plants.

This paper will discuss minor changes to gasification plants that plant operators can implement which will maximize the value of their assets, and enable them to easily create a product with higher purity and productivity.

The recent Air Products news release about its plans to construct the UK's largest waste-to-energy gasification facility is a shining example of the rising trend in larger gasification facilities that the greater renewable energy industry is seing today. Gasification facilities are a unique and economical way to transform the waste we produce as a modern civilization into our own, renewable energy. And the potential of these facilities is staggering.

> "...the increase in productivity from the final gas product can increase 25 percent or more"

Sweden might be the best example of a country truly putting waste-to-energy technology to good use – not only have they built several biogas, biomass, and gasification facilities, they also have such efficient operations that they literally find it economical to import garbage for energy transformation. That's right, the Swedes are buying other countries' trash. Incredible.

As these facilities proliferate, though, it lends the question what will be done in the future as the facilities become bigger and more efficient? To answer that, take a step back and look at why these facilities are becoming more popular in the first place. First is the abundance of a fuel source; the garbage, landfill gas, crop chaff, wood chips, crop waste, food waste. More important to the spread of this technology though, is the relative energy contained in the end product, syngas.

Syngas is appropriately used in boilers and can easily be converted to heat, hot water, cooling using evaporative equipment, and also electricity. What makes syngas so useful is the hydrogen content of the blend. Hydrogen has a very high heating value by mass, nearly triple that of natural gas. Therefore, maximizing the efficiency of syngas plants can be done by increasing the output of hydrogen with the same amount of feedstock. Sounds like magic, right? Well it isn't, and in fact this is easily done with low cost equipment.

Using a shift gas reactor, gasification facilities can increase the hydrogen content of their syngas by reacting the prevalent carbon monoxide with steam. The heat catalyst starts a chemical reaction between the carbon monoxide

$$H_2O + CO \longrightarrow H_2 + CO_2$$

in the syngas and the heated water in the shift reactor as shown by the equation below:

As you can see from the equation, there is a carbon dioxide byproduct from this reaction. Unlike in combustion facilities which must capture $CO_2$ from super heated combustion exhaust, $CO_2$ can more easily be taken out of the process's waste stream from the reactor with low cost carbon capture and storage (CCS) technology. Paired with CCS, a biomass gasification facility with a shifting reactor produces:

- A higher energy content, pure hydrogen product
- Zero carbon emissions ($CO_2$ and CO)
- Slight amount of heat (exothermic process)

While a shift gas reactor may cost only 10 percent of the total investment of a gasification facility, the increase in productivity from the final gas product can increase 25 percent or more, depending on the composition of the syngas. The operating expense of a shift reactor is minimal as catalysts are available to achieve the process for a range of temperatures, high and low. Standard hydrogen production equipment manufacturers can provide shift conversion equipment to syngas facilities here and now. While hydrogen gas already demands a high price for its traditional uses in chemical, industrial, mechanical, and refining operations, the price will surely rise steadily as demand from new and existing fuel cell applications strains the supply from existing hydrogen production facilities.

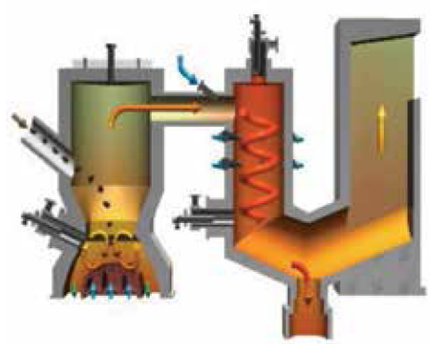

**Figure 1:** Gasifier and syngas Processor
Courtesy: Oklahoma State University

Creating hydrogen from syngas is an economical way for gasification plants to maximize their assets' value, while also hedging for future developments.

**About the authors**

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