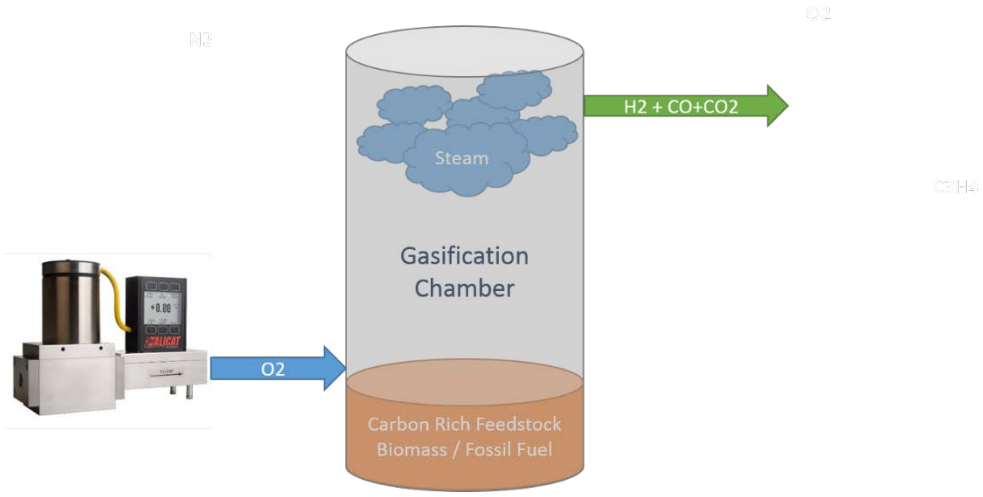
High Flow control for Gasification

Gasification is a process in which biomass or fossil fuel is converted into syngas (synthesis or synthetic gas). According to Carnot's theorem of thermodynamic efficiency, this syngas is more efficient than organic fuel in its combustion due to higher operation temperatures. Furthermore, syngas can be used directly in gas engines, kilns, boilers and thermal oxidizers. In some parts of the world, syngas made from biomass is less expensive than fossil gas and can be directly substituted in most applications. The quality of the syngas produced depends on the composition which ultimately depends on precise control of oxygen or air entering the gasification chamber.

Syngas can be created from a feedstock of biomass, municipal solid waste, medical waste and even hazardous waste. While the amount of pollution created depends upon the feedstock, syngas burns cleaner than fossil fuels and has much fewer emissions than greenhouse gases.

Creating Syngas



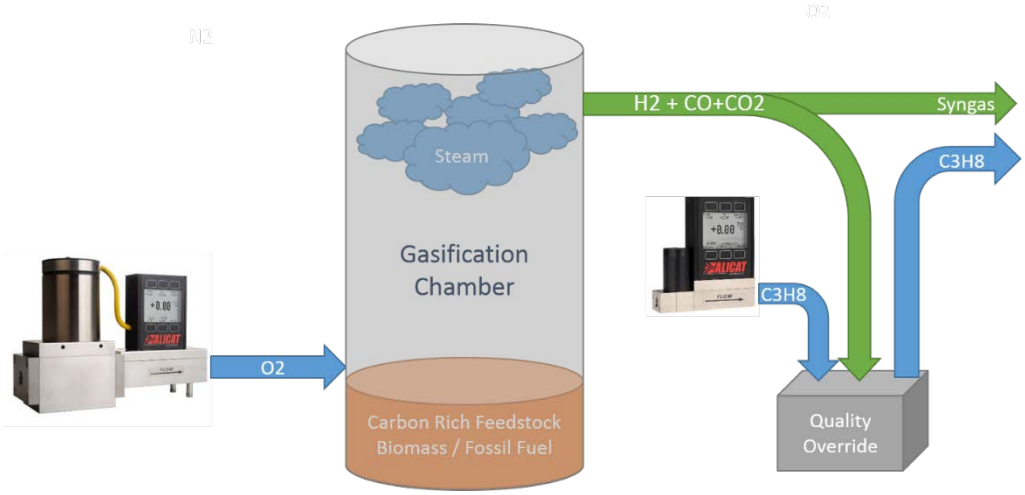
Syngas is typically created from three major components: carbon, oxygen and steam. The carbon and steam are created by heating the fuel, and the oxygen is artificially introduced.

The added oxygen will interact with the steam and carbon to ultimately create a mixture of hydrogen, carbon monoxide and carbon dioxide. The particular composition of the syngas is dependent on the amount of oxygen added to the system. Too much added oxygen will result in a higher concentration of carbon dioxide, and a correspondingly lower concentration of carbon monoxide lowering the overall quality of the syngas and limiting its applications.

Due to the large size of most gasification chambers, a large flow rate is required. A large mass flow controller is an accurate way to reach the large flow rates needed with the accuracy needed to create syngas with a precise composition. Alicat's MCR-series controllers use near-

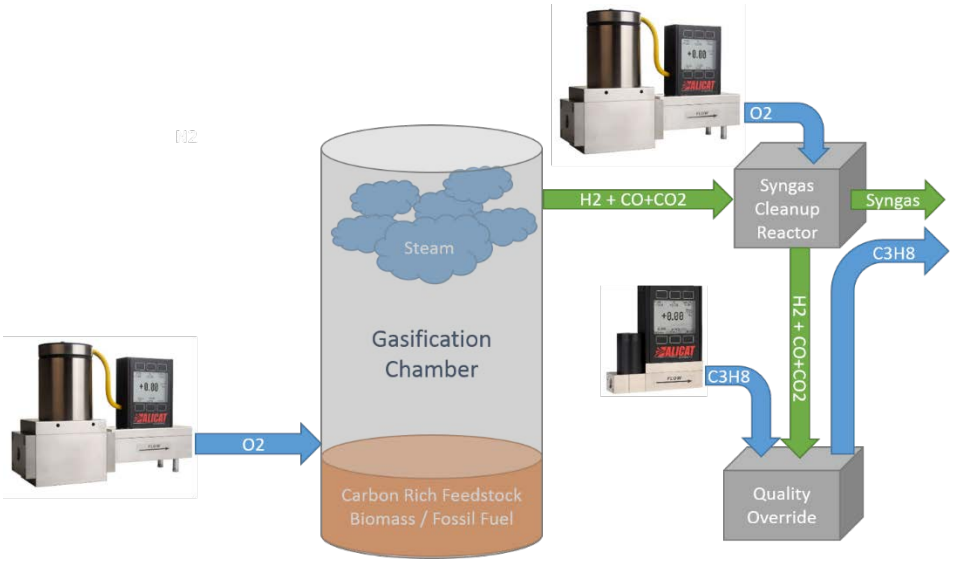
frictionless Rolamite proportional control valves to rapidly and precisely control flow rates up to 5000 SLPM. With an accuracy of +/- (0.8% of reading + 0.2% of full scale range) extending to these high flow rates, precise composition can be ensured.

Improving a Poor Batch



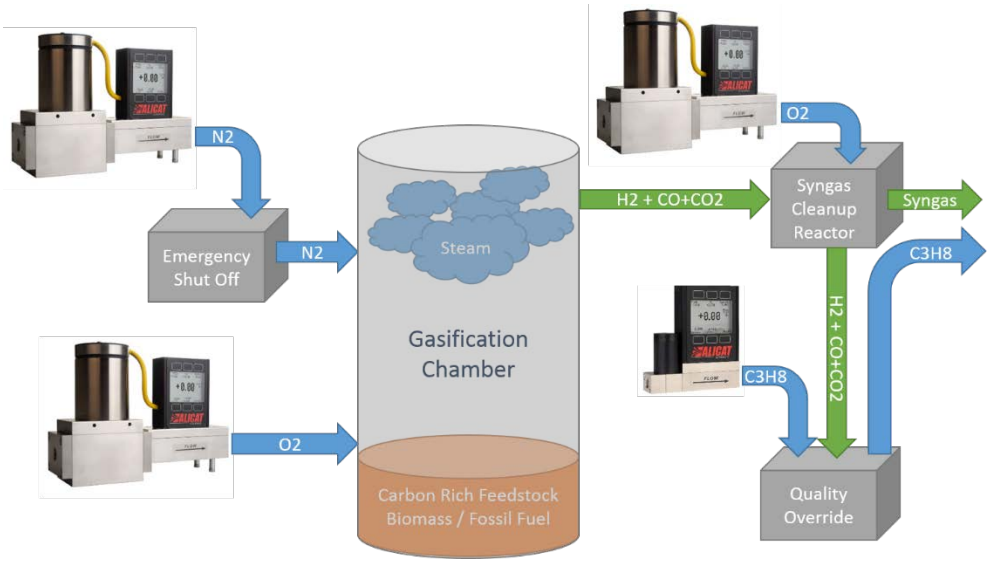
While the flow rate of oxygen can be precisely controlled, occasionally the concentration of the syngas is not as expected due to unforeseen variations in the feedstock or experimental setup. To combat this issue simple quality control check can be inserted. When the quality of the syngas is reduced, usually by a creating a larger percentage of CO2 than is desired, an Alicat mass flow controller can be used to add propane to the mixture, rather than requiring a lengthy full system restart. This new mixture will more closely match the chemical properties of the desired composition and can be used in most applications. This compensation can be done easily via serial communication and integrated into an existing quality check program.

Further Refinements

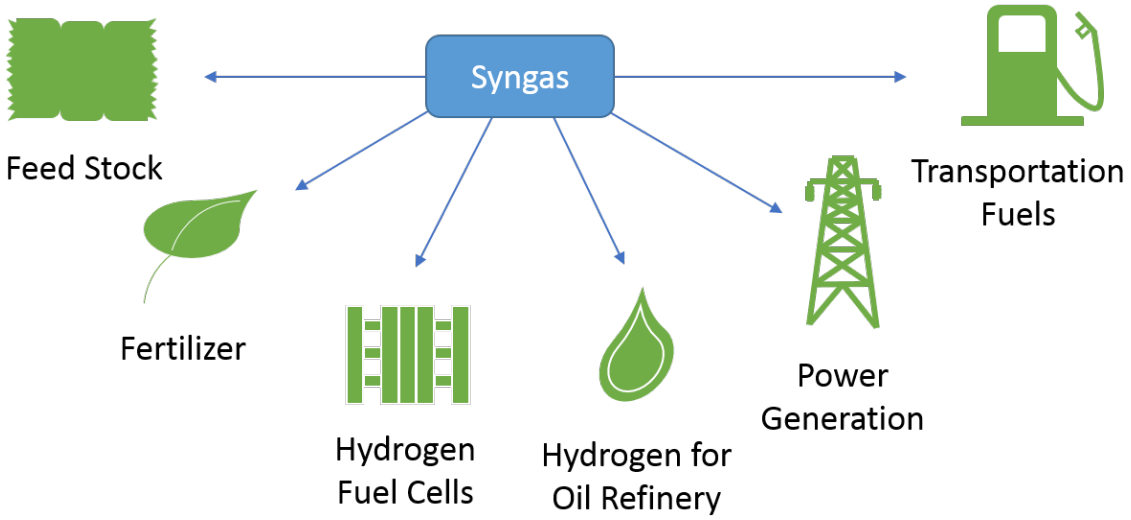


After the syngas has been created, a syngas cleanup reactor may be used to remove tar particulates. Particulates can be removed using cyclonic separation. In a cyclone separator with secondary input, oxygen is sprayed through nozzles creating a vortex. The particulates will be unable to follow the tight curve of the vortex due to the increased inertia caused by their larger density. An Alicat mass flow meter's high accuracy can ensure that particulates of the right density are separated efficiently. The syngas can be further cleaned with oil or water scrubbing to remove tar.

Ensuring Safety



When working at such high temperatures with potentially combustible materials, purging the system quickly is sometimes necessary for safety. A safety shut off system can easily be configured with a mass flow controller to flood the chamber with nitrogen. These controllers can be built with a CSA Class 1, Division 2 (ATEX zone 2) area classification to ensure that local fire safety regulations are being met.



The primary output of gasification, syngas, can be used for hydrogen fuel cells, power generation, transportation fuels, etc. A common secondary product, biochar, which is created from biomass gasification, has many applications including energy storage in batteries, electromagnetic radiation shielding, food colorants, humidity regulation, carbon fertilization and pesticide treatments. When operating at high temperatures, gasification will produce liquid stone and metal instead of biochar. These liquids can then be used in many industries including construction and landscaping.

Alicat Scientific mass flow controllers can be used in multiple areas of the gasification process: combustion, clean-up reactors, safety, and quality control. This versatility allows for simple communication between various parts of the gasification system.

The quality of the syngas produced is dependent upon accurate and repeatable flow of oxygen into the gasification chamber. For more information about Alicat's high-flow controllers, visit http://alicat.com/MCR.