

Entrained Flow Gasification

Most entrained flow gasifiers (EFGs) are vessels where the fuel is injected and partially oxidized in one or more burners, and where the residence time is sufficient to complete the reactions—including both gasification of the solids and decomposition of tars and other hydrocarbons—within a few seconds. For this reason, the fuel must either be a pumpable liquid that can be dispersed to droplets in the burner nozzle or small particles (<1 mm) that can be consistently fed by means of dense phase transport to the fuel register of the burner.

EFGs also typically operate in an ash melting mode—i.e., the ash is removed as slag in the bottom of the reactor. This requires operation at very high temperature (e.g., 1,500°C) to reduce the slag viscosity and make it free flowing to avoid buildup of slag in the reactor. To reach such high temperatures with low-energy-content feedstocks and still retain a significant heating value, the use of oxygen mixed with steam is required. It is not possible to use air.

EFGs are also typically pressurized up to 1–3 MPa for solids or even higher for some high-energy liquids. The high gas velocity and short reaction time at pressure makes it possible to scale this type of technology to large capacities, up to 400 MW or more. However, the complexity of fuel preparation in the case of solids and the requirement of using oxygen typically do not make small installations feasible.

One advantage of this gasifier type is the ash melting, which yields a dense slag by-product with less leaching rate. Since many lighter inorganic species and heavy metals are evaporated at the high temperatures in the gasifier, such dense slag may even be recycled as construction material.

There are also other forms of EFGs where fuel is injected into a gasifier or pyrolyzer and the resulting gas and char solids are heated indirectly by radiation and convection in several heated tubes. The tubes are then heated on the other side by firing product gas and/or char to heat the tubes.

In addition, a type of “entrained flow” post-treatment is common downstream of fixed or fluidized bed gasifiers to reduce the tar content from the gasifier itself. Such devices can be air- or oxygen-blown and are sometimes assisted by a plasma generator.