Flexible TwoStage biomass gasifier designs for polygeneration operation

As increasing amounts of wind and solar are integrated into the energy system, there is a growing need for the development of flexible and efficient biomass-based energy plants. Currently, a Polygeneration concept is being investigated: a system based on thermal biomass gasification and solid oxide cells that can either produce power or biofuels depending on the electricity prices. This study investigates gasifier design opportunities for large-scale and fuel flexible TwoStage concepts that only applies partialoxidation for tar conversion. Thermodynamic modeling is carried out for a total of 12 gasifier cases, featuring 3 main systems that each can process wood/straw and use air/oxygen. It was found that despite the varying operation conditions, process parameters remained relatively stable and that partial oxidation could be effectively applied as the only tar reducing measure. The systems all achieved high cold gas efficiencies of 84-88% and were found to be significantly more effective than competing technologies, while also obtaining higher fuel flexibility.