Studies on the development of the new energy sources

Psychology, Child Development

There has been a significant global tendency towards renewable energies during recent years. Environmental problems, energy crisis, population growth and the depletion of fossil fuel sources are among the reasons behind the increasing attention to the development of new energy sources. Biomass is a renewable energy source which is known as an alternative to fossil fuels due to its abundance and eco-compatibility. Biomass is also a CO2 neutral resource because it’s burning releases the same amount of CO2 in the atmosphere that has been consumed in the photosynthesis process.

Gasification is a common method to exploit energy from solid and/or liquid fuels which is done in the presence of a gasification agent. Biomass gasification refers to biomass reaction with air, pure oxygen or steam finally leading to production of syngas, condensable components (tars) and char. The amount of produced char and tar depends on various factors such as operating conditions, fuel composition and gasifier hydrodynamics. The produced syngas can be directly used as a fuel for the production of electricity or used as a feed for the synthesis of other liquid or chemicals. Despite the high potential of biomass gasification to become a reliable method for syngas production, more studies are required to remove the technical barriers of biomass gasification such as tar formation and ash fouling.

Tar can lead to serious operational problems in downstream equipment such as coolers, filters and channels imposing much cost on the system. These problems have caused producer gas applications to require the removal of at least some of the produced tar before the produced gas is used. Thus, tar

control and removal are vital issues for the development of biomass gasification in industrial scale. Catalytic gas cleaning is one of the most promising methods for tar removal providing multiple advantages. For instance: the tar can be totally removed, it is more cost effective than other methods, and the tar can be transformed into a product syngas with high caloric value. However, the catalyst deactivation due to coke formation is often considered as a serious challenge in the application of catalysts and bed materials. Dolomite which is used as an in-bed additive in biomass gasification can significantly remove tar. Its relatively suitable resistance against deactivation is another advantage of dolomite in comparison to other additives and catalysts.

Roche et al. studied the influence of dolomite on the product yields of air-steam gasification of sewage sludge in a fluidized bed gasifier. The use of dolomite enhanced the H2 content and decreased the tar yield under the tested conditions. Hu et al. used a fixed bed gasifier for the production of hydrogen gas from steam gasification of apricot stone with olivine and dolomite. The results showed that the calcined dolomite had a better catalytic activity in terms of H2 production, compared to calcined olivine. Corella et al. compared four competitive additives including calcined dolomite, natural and sintered olivines, and Ni-olivine catalyst for their effect on the tar yield and the output of the process.

The results showed that the dolomite was more active than olivine in biomass gasification with air as a gasification agent. Mun and Kim studied the air gasification of dried sewage sludge with calcined dolomite in a two-

stage fluidized bed gasifier. The use of dolomite as the bed additive and activated char removed the most tar and generated the highest hydrogen content. Baratieri et al. used different types of dolomites as catalyst during oxygen-gasification of biomass in a lab scale atmospheric fluidized bed. Their results showed that dolomite was reduced the tar content in the producer gas and at the same time increased the syngas yield.

Many studies have been performed focusing on the biomass gasification with Ni-based catalysts giving valuable information about the catalyst performance and lifetime. In contrast, only a few researches have been performed using calcined dolomite as a catalyst in biomass gasification. Therefore, this work is focused on biomass gasification with calcined dolomite. This research also explores the influence of equivalence ratio (ER) and gasification temperature on gas composition and product distribution.