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## Gasification of biomass wastes under different operating conditions: Producer gas quality and biomass interchangeability

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Forestry (pinus pinaster pruning), agricultural (grapevine tree pruning) and industry (dealcoholized marc of grape) wastes can be considered as the main biomass sources for energy from the inland regions of Spain, the first being a typical waste from forest maintenance and timber harvesting and the others being typical wastes from unirrigated agriculture and distillery industry, respectively. Pruning of pine is made every five years (on average) with a production of around 5 tonnes per hectare, and pruning of grave pine is made yearly with a production of 0.83 tons per hectare. The production of marc of grape is around 0.14 kg/kg grape (on average). European and Spanish energy policies are encouraging the use of biomass for energy purposes, with three targets: economic and social development of the countryside, elimination of wastes and reduction of CO2 emissions. However, such policies have not been successful yet in Spain owing to uncertainties in the guarantee of provision of raw material, to fluctuations of the raw material prize and to administrative difficulties, leading to the discouragement of investors. In this frame, biomass gasification constitutes an attractive option, and an alternative to the combustion of biomass. The producer gas from gasification can be directly used in internal combustion engines for mechanical or electrical energy production. One of the main advantages of gasification is the possibility to install small, low-cost and efficient gasifier-engine couples, which allows the biomass to be used close to source, and thus, the elimination of much of the storage and transportation costs. Additionally, the combination of short-run forestry and agricultural wastes for supplying power plants provides higher operation flexibility and minimizes the effect of seasonal supply variations. However, the gasifier design must be optimised as a function of the physical and thermo chemical parameters of the biomass, while the engine design must be optimised as a function of the producer gas composition. As a consequence, only where these compositions are substantially similar, the original biomass wastes can be used in a flexible supply system. The producer gas compositions obtained from the gasification of the above mentioned wastes in a circulating flow gasifier have been compared in order to determine whether these wastes can be used in combination or interchangeably in gasification systems. Experimental tests were carried out not only considering different fuels but also several operating conditions (equivalence biomass/air ratio, gasification temperature and type of gasifying agent (air, air/steam mixtures).

## Biodiesel production using manganese carbonate as catalyst in subcritical methanol

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Among the options explored for alternative energy sources, biodiesel is one of the attractive alternatives due to its renewability, biodegradability, and non-toxicity. The most common way to produce biodiesel is through transesterification, especially alkali-catalyzed transesterification. Unlike homogeneous, heterogeneous catalysts are environmentally benign and could be operated in continuous processes. Moreover they can be reused and regenerated. Therefore, heterogeneous catalysts are now being tried extensively for biodiesel synthesis. Our research aims to find cheap solid base catalysts with high catalytic activities and long life. In this research, manganese carbonate catalyst was prepared by precipitation method and was used in transesterification reaction under subcritical condition. Catalyst samples were characterized by X-ray diffraction (XRD), Fourier transform infrared (FT-IR) spectroscopy, scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS). The triglyceride (TG) conversion and FAME yield were determined using high performance liquid chromatography (HPLC). The transesterification reaction conditions were optimized for catalyst amount, molar ratio of methanol to oil, and transesterification reaction temperature and time. Experiment results showed that a maximum TG conversion of 98.06% was obtained using MnCO3 catalyst at the optimal reaction conditions. In continuous transesterification, the catalyst could maintain a high catalytic activity in 15 days and shown low leaching in both biodiesel and glycerol phase.

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