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Thermal drying, direct combustion & gasification of biomass residues for its use as combustible to produce thermal and electrical energy

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Biomass materials and agricultural wastes (such as forestry wood, bark, plants, etc.) have moisture content (MC) commonly more than 50 mass % (wet basis). Higher biomass MC generally causes operational problems of biomass combustors. Also, higher moisture contents lead to high CO and VOC (volatile organic compound) emissions, mainly in smaller combustion units. Using dry biomass in a combustion systems results in lower emissions, reduced fuel use, improved boiler efficiency, increased heat production, reduced ancillary power requirements. The main purpose of the drying process is to reduce moisture content of the wet biomass. The choice of dryers will depend on the characteristics of the wet biomass material, the source of heat and the integration options available. The heat sources and temperatures for drying are important considerations. Flue gas is an efficient source of the heat. A method of calculation for thermal drying has been developed for the design of a direct contact dryer for biomass residues. A heat source of dryer will be flue gasses of the existing biomass boiler. The model input data are inlet temperatures and the flow rates of gas and biomass residues. An experimental facility has been developed and built in order to measure the temperatures inside the dryer along time. The results obtained indicated that an optimal dryer length of approximately 0.95m has been calculated for an inner diameter of 0.13m. In the gasification experiments of biomass 10 g of vine shoot were treated at three temperatures (650, 750 & 800°C) in air atmosphere. Once the optimal temperature (800°C) was selected, the wine shoot remnants were gasified by using an air stream of 200 ml/min and different residence times (8 and 50 minutes, respectively). In our case, the total amount of vine shoots produced yearly in Extremadura reaches 87725 Tons, so a volume of 1.91*107 m3 of H2 may be obtained annually. Multiplying by its lower heating value yields to H2 energy potential of 205766 GJ per year. Keeping in mind Doubling's Law, a total power of 30.01 MW could be obtained. Considering a yield of 21% for the solid phase obtained in the gasification process, 18900 tons of carbon might be produced yearly. The energy potential of the carbons could be obtained by multiplying by its HHV, which would result in an electrical power of 2 MW, considering 20% global yield of the process.

Biography

Awf Al-Kassir, Professor Industrial Engineer, (Ph.D.) from Valladolid University in 1995, graduated (B.Sc.) from mechanical engineering department, Mosul University in 1978. He worked for University of Technology in 1979 and Institute of Technology of Ramady 1980-1988 after getting his (M.Sc.). From 1989-1994, he worked as a researcher and associate professor at the University of Valladolid. From 1995 up to date he worked as a professor at the University of Extremadura in Spain. He was invited professor at TUBITAK research center of Turkey during the academic year 2009-2010. Also he is the coordinator of Master Bioenergy Subject at the Polytechnique Institute of Portalegre in Portugal, 2010-2011. Now he has published more than 150 papers and contributed more than 80 communications to congresses & other books. He was a member of ASHRAE from 1989-1995, he was accepted for colligate in the engineering college of Spain since 1990.

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