

Pyrolytic liquid fuel: a source of renewable electricity generation in Makkah

ABSTRACT

Millions of Muslims from all over the world visit the Holy Cities of Saudi Arabia: Makkah and Madinah every year to worship in form of Pilgrimage (Hajj) and Umrah. The rapid growth in local population, urbanization, and living standards in Makkah city along with continually increasing number of visitors result in huge municipal solid waste generation every year. Most of this waste is disposed to landfills or dumpsites without material or energy recovery, thus posing substantial environmental and health risks. The municipal plastic waste is the second largest waste stream (up to 23% of total municipal waste) that is comprised of plastic bottles, water cups, food plates, and shopping bags. The sustainable disposal of plastic waste is challenging task due to its clogging effects, very slow biodegradation rates, and presence of toxic additives and dyes. Pyrolysis is one of the promising waste-to-energy technology for converting municipal plastic waste into energy (liquid fuel) and value-added products like char. The produced liquid fuel has the potential to be used in several energy-related applications such as electricity generation, transportation fuel, and heating purposes. It has been estimated that the plastic waste in Makkah city in 2016 can produce around 87.91 MW of electricity. This is projected to increase up to around 172.80 MW of electricity by 2040. A global warming potential of 199.7 thousand Mt.CO₂ eq. will be achieved with savings of 7.9 thousand tons emission of CH₄, if pyrolysis technology is developed in Makkah city. Furthermore, a total savings of 297.52 million SAR from landfill diversion, electricity generation, and carbon credits would be possible to achieve in 2016 from pyrolysis. These economic benefits will increase every year and will reach up to 584.83 million SAR in 2040.

Keyword: Greenhouse gas (GHG); Liquid fuel; Municipal plastic waste (MPW); Pyrolysis technology; Sustainable environmental solution (SES)