Development of a protocol to defined end of waste criteria regarding the use of tire pyrolysis oil in the framework of energy recovery

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Abstract

Most waste streams have ceased to be considered a "problem" especially over the last 15 years where they need proper treatment to protect human health and the environment, paying the corresponding high financial management costs. Waste is now considered as a resource and as such is managed by developed social and economic countries. Such a stream of waste is the tires at the end of their life cycle. End-of-life tires due to their significant energy content are being used on a pan-European basis as an alternative fuel, overwhelmingly in co-incineration cement plants, as well as in Cyprus. According to the existing European Directives, waste can only be burned under incineration / co-incineration conditions. Anyone who wants to burn waste with other conditions then the waste first has to go through the declassification process. For this reason, this research is attempting to define an "end of waste criteria" for the declassification of tire pyrolysis oil (TPO). It is noted that the declassification of tire pyrolysis oil has not yet been carried out by any other European Member State. The Waste Framework Directive 2000/98 (WFD) contains specific requirements to define end-of waste criteria (EWC). The main goal of EWC is to remove and eliminate the administrative loads of waste legislation for safe and high-quality waste materials, thereby facilitating and assisting recycling.

The purpose of this research is to investigate the ability to manage and exploit the energy content of tire waste through pyrolysis technology as incineration/co-incineration technology presents some significant negative characteristics. The most important of these are low energy recovery and the need to install anti-pollution systems for air emissions. Pyrolysis technology is a promising technology for tire waste management. It becomes particularly economically viable and attractive if the TPO resulting as a pyrolysis derivative can be declassified from waste and used as a fuel in internal combustion engines for power generation. The research indicated that the TPO as it is produced by tire pyrolysis is extremely difficult to use itself in internal combustion engines. The main reasons are that raw TPO has high concentrations of moisture and sulphur, has a high viscosity, may contain solid particles and has a low number of cetanes.

SWOT Analysis is conducted for the use of TPO as an alternative fuel as well as, a bibliographic review is made of the quality characteristics of TPO, its conditions of production, statistical data on the annual quantities of used tires produced in Cyprus and Europe. The proposed protocol defined criteria for the viscosity, water content, ash, calorific value, heavy metals, PCBs etc. A major negative issue for the use of TPO is the chlorine content which was set up to 5 ppm. Chorine contents are extremely responsible for the emission of dioxins and furans due to the presence of

chlorine in the TPO. The limit of 5 ppm was a) as it was discovered that common fuels contain chlorine of about 5 ppm; b) this limit is adopted in ASTM D4806-11A for the use of bioethanol as a fuel; and c) in the Processe Fuel Oil Quality Protocol, issued by the Northern Ireland Environment Agency and the Scottish Environment Agency, also adopts the limit of 5 ppm.

Keywords : tire pyrolysis oil, end of waste criteria, TPO, energy recovery, circular economy, industrial symbiosis