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Design, manufacture and optimization of a used oil burner for metallurgical melting furnaces.

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The availability of Used Engine Lubrication Oil (UELO) is tremendously increasing in Tanzania following a sudden rise in the number of motor vehicles plying the roads all over the country. Since the current consumption of this oil is below the generated amount, hygienic and environmental friendly disposal of the oil is a problem. This research has been conducted to investigate possibilities of the used engine lubrication oil as a fuel in cast iron metallurgical melting furnaces. It focused on identification of physical and chemical properties can be accommodated in the design of an oil fired burner. Experiments were carried out to establish basic physical and chemical properties of the oil and hence its behavior model. Physical properties investigated includes Specific Gravity (SG), viscosity variation with temperature, Flash Point (FP), Burning Point (BuP), Pour Point and Boiling Point (BP). Others were Water content, Sediment content and oil/water Miscibility. Chemical properties investigated included the Total Acid Number (TAN) or the Total Base Number (TBN), Ash and Sulphur content, Carbon residue and Copper strip tests. Most of the tests mentioned above were also done to other relatively similar fuels (i.e. Industrial Diesel Oil (IDO) and the fuel Oil (FO) or commonly referred to as Furnace Oil for comparison purposes. Ultimate analysis of the used engine lubrication oil indicate possibilities of this oil to burn with a higher flame temperature compared to that of Diesel Gas Oil (DGO), Industrial Diesel Oil (IDO) and Fuel Oil (FO). Qualitatively, results from all tests done as outlined above revealed a close similarity in trend of behavior between used engine lubrication oil and comparable fuels. The used engine lubrication oil has proven even better than other fuels in the context of air pollution particularly due to its low sulphur content. It has higher flash point and burning point thereby indicating that it is much more difficult to burn than diesel gas oil, industrial diesel oil and fuel oil. Carbon residue is higher in used engine lubrication oil than is in comparable industrial furnace oils. Further experiments were done on test rigs for Low Air Pressure (LAP) burner and the Rotary Cup Burner (RCB) models using this used engine lubrication oil in order to determine among others; the minimum used engine lubrication oil preheating temperature. Another test was conducted to determine used engine lubrication oil flow rate in relation to oil temperature for Low Air Pressure (LAP) burner and the Rotary Cup Burner (RCB). Atomization pattern dependence on oil temperature and atomizing air flow rate were also investigated for the low air pressure burner. The air flow rate for the blower which is an integral part of the low air pressure burner were also determined. It was established that the minimum preheating temperature for used engine lubrication oil for use on a low air pressure burner is 70°C and that preheating above 120°C does not improve atomization properties as oil viscosity stabilizes above this temperature.

Atomization is also a function of air flow rate and comparison between atomization pattern of the low air pressure burner and the rotary cup burner has shown that atomization is finer in the rotary cup burner.