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Waste to Energy: Food Waste Valorisation toward Biofuel Production

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The uncontrolled and excessive use of fossil fuels is one of the main culprits for global warming due to the emission of greenhouse gases. Therefore, intensive work has been done to reduce the use of such fuels by replacing/adding biodiesel in transport sector since the use of biodiesel decreases the net emission of greenhouse gases by about 76 % than when using petroleum diesel (Ivaniš et al., 2016). On the other hand, the modern consumer lifestyle has led to the accumulation of large amounts of waste that additionally pollutes the soil and water, which indicates the necessity of a global transition from a linear to a circular economy where waste represents raw material.

The disposal of used cooking oil is a huge problem because it is usually poured down drains, which leads to clogging of kitchen pipes and local sewage. Consequently, waste cooking oil drastically reduces the efficiency of wastewater treatment plants and is extremely harmful to the aquatic ecosystem. The reuse of used cooking oil in food is not recommended so other forms of recycling such as biodiesel production are preferred. Biodiesel is obtained by the transesterification reaction of vegetable oils with short-chain alcohol in the presence of a catalyst, and glycerine is produced as a side product. By applying heterogeneously catalysed transesterification reaction, such as the use of CaO as catalyst, the generation of waste during the purification of products is avoided. Eggshells are solid organic waste that is generally discarded without prior treatment, making it a hazardous waste. It is considered that the eggshell mainly (about 96 %) consists of $CaCO_3$, which offers the possibility of its revalorisation through CaO production (Waheed et al., 2020).

As part of our research, waste hen's eggshell was collected and annealed at 830 °C producing CaO, which was used as a catalyst in the biodiesel synthesis from used cooking oil. The thermodynamic and transport properties of the obtained biodiesel and crude glycerine were determined at wide ranges of temperature and pressure, which is relevant for their further use [1]. The measured properties of the obtained biodiesel meet the limits prescribed by the standard for biodiesel EN14214 which confirms that it can be used in diesel engines and heating applications. The obtained raw glycerine can be mixed with biomass residues and used in the production of pellets. In this way, the problem of accumulation of waste in the form of eggshells, used cooking oil and crude glycerine is solved and their revalorisation is carried out, which is fully in accordance with the postulates of the circular economy. Furthermore, biodiesel, as an environmentally friendly alternative to petroleum diesel, was obtained.

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