CORK WASTES AS ENERGY SOURCES

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ABSTRACT

This document deals with the use of cork wastes form cork processing for energy production. Two residues were identified as interesting proposals for energetic valorization: cork powder (CP) and cork boiling wastewater (CBW). In cork processing operations an important waste is produced, cork powder, estimated to reach over 30,000 [tons/year]. The various types of cork powders have higher calorific values ranging from 4,000-7,000 Kcal/kg. This powder is commonly burned to produce steam or heat. Cork boiling wastewater is an aqueous and complex effluent of the cork industry which is produced during the boiling of the cork planks. This boiling wastewater has no utility, being a serious environmental hazard. Anaerobic digestion is a promising technology for the treatment of organic effluents and for the simultaneous recovery of its energetic potential through methane production. Its application to cork effluents was studied. The resultant methane potentials were 0.126 - 0.142 [m^3 CH_4 kg^{-1}] COD.The calculated total volume of CBW produced yearly in Portugal is 30 374 [m^3] and the total CBW volume produced in Portugal in one year corresponds to a total energy value of 165 400 [kWh]. Preliminary experiments were also carried out in order to evaluate the use of cork wastes in different states, as substrate in a dark fermentation process for hydrogen production (bio H_2) with simultaneous valorization The best bio H_2 production yields 56.3 [$mLH_2/gSV_{Substrate}$] with a gas purity (H_2/CO_2) of 2 using 2.5 $SV_{cork\ Wastes}/L_{FM}$ of cork granules sampled before treatment in autoclave (cork AT).

Keywords: cork, cork wastes, cork powder, energy, biogas,biohydrogen

INTRODUCTION

Cork industry is an important economic and social sector in the western Mediterranean region. Portugal is the producer and processing leader of this sector. The total quantity of cork produced worldwide is nowadays referred as being of about 200,000 ton/year and Portugal produces about half of this. Different cork raw materials (e.g. cork from forest and cork processing wastes) are used for different cork products. The global cork processing scheme is shown in Figure 1. As can be seen, cork processing is a complex process, since there are a great variety of raw materials and very diverse cork products for different applications.

In cork processing operations important wastes are produced, e.g. cork powder (CP) (e.g. from grinding, sanding) and cork boiling wastewaters (CBW). These wastes are already or can be used for energy production.

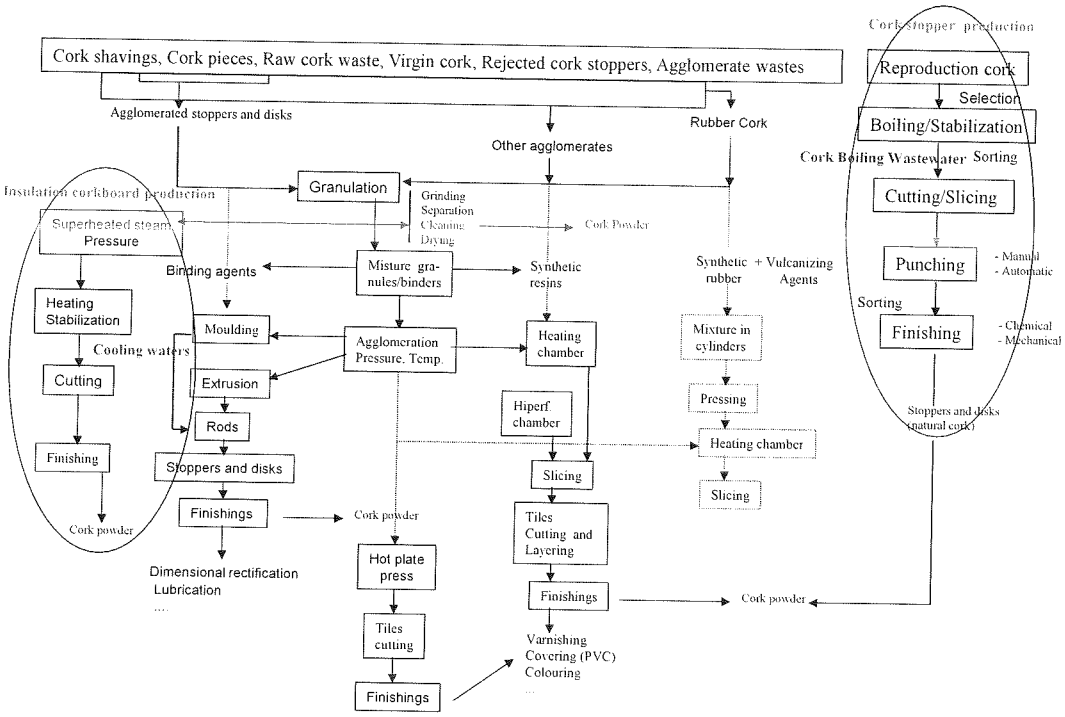

Fig. 1 - Global scheme of cork processing showing wastes.

RESULTS AND DISCUSSION

CP is the main waste of the cork industry (~30,000 tons/year). There are various types of cork powder, depending on the processing step of cork, with high calorific values ranging from about 4,000-7,000 Kcal/kg [1] and neutral with regard to CO_2. This powder is commonly burned to produce steam and/or energy, e.g. a cork company that produces cork products for construction meets 60% of its energy needs using CP [2].

Fig. 2 – Cork powder

Some preliminary experiments were also carried out in order to evaluate the possibility of production of biohydrogen from a pre-treated CP, as a carbon source, with separation in a liquid and in a solid phase and then using microorganisms (*Enterobacter aerogenes* ATCC 13048*)* aiming at these fuels. In this work, a dark fermentation process for hydrogen production has been developed using, as substrate, different CPs (dimensional finishing of cork stoppers) and also cork granules from two different steps of insulation corkboard production (before and after agglomeration) in different states (initial concentration 2.5 [$gSV_{Substrate}$ /$L_{Fermentation\ medium}$)]. The best H_2 production yield was 56.3 [$mLH_2/gSV_{Substrate}$] and was achieved for CP and other materials from the manufacture of insulation corkboard, respectively [5] with a gas purity (H_2/CO_2) of 2 using 2.5 $SV_{cork\ Wastes}/L_{FM}$ of cork granules sampled before treatment in autoclave (cork AT). The results achieved were promising, considering the conversion of cork wastes into an energetic vector. More studies are needed in order to optimize the operational parameters.

CBW is an aqueous and complex effluent of the cork industry produced during the boiling of the cork planks. It contains organic materials such as phenolic compounds. This boiling wastewater has no utility, being a serious environmental hazard. As anaerobic digestion is a promising technology for the treatment of organic effluents and for the simultaneous recovery of its energetic potential (methane production), assays were carried out to determine the gas potential and biodegradability of the substrate using a mesophilic anaerobic consortium, performed at different CBW concentrations of kg COD [m^{-3}]. The methane potentials were 0.126 - 0.142 [m^3 CH_4 kg^{-1}] COD [3] and so the polluting organic load contained in CBW can be converted into an energy carrier gas. The calculated total volume of CBW produced yearly in Portugal is 30 374 m^3. This amount can originate a total energy value of 165 400 [kWh] [4].

Other wastes were also identified for treatment and energetic valorization. For exemple the sludges from the CBW recovery tanks and the insulation corkboard cooling water. These wastes are less important in quantity and have presumably less energetic potential, but will also be studied in the future.

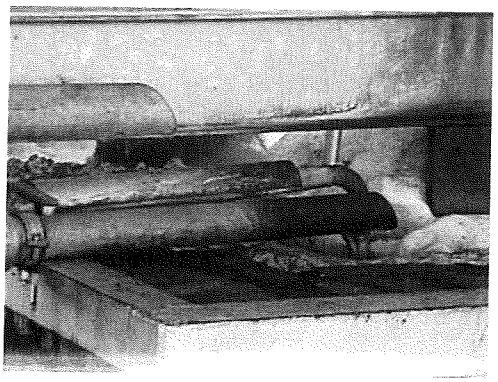

Fig. 3 – Cork boiling

CONCLUSIONS

Cork wastes can be used as energy sources and that the use of cork products is very sound from the point of view of the energy. In addition to above, the preliminary results presented in this work also show the feasibility of converting cork wastes generated in the Portuguese cork industries (abundant and low-priced) into higher value products, representing a promising route to achieve economic viability in the biofuels industry. Other wastes from the cork industry may be studied in the future for this purpose.

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