Investigation of thermal degradation of hydrolysis lignin

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Recently more attention is being paid to wood biofuels, which are renewable energy sources and take the fourth position in the world energy balance after coal, natural gas and oil that are connected with some factors. One of these factors is development of wood biomass energy utilization technologies. Thus, there is a huge possibility of utilization of side product of wood treatment – lignin which is 40% of dry mass of wood.

In the technological cycle of hydrolysis industry lignin is being produced, which is a complex of components of different chemical structure. Hydrolysis lignin is composed of: mainly of changed lignin of vegetative cellulose (40-88% of dry mass); polysaccharides (13-45%); components of lingo humic complex (5-19%); non-washed monosaccharides after hydrolysis process; mineral and organic acids: mainly sulfur, formic and acetic, ashes and some other components.

Acid hydrolysis of wood and agricultural residues for the production of ethanol, fodder yeast, hexose and pentose sugars and their derivatives (i.e. furfural and xylitol) had industrial applications in Soviet Union and Bulgaria. It was based mainly on percolation hydrolysis using diluted H_2SO_4, which was developed in the former USSR and used from the 1930s to the 1990s, although some semi-industrial facilities for wood or agricultural residue hydrolysis using concentrated HCl were also used during this period. Wood hydrolysis facilities were built in both northern and southern European regions of Russia, as well as in Siberia and the Russian Far East. Other hydrolysis plant in the former USSR were located in Ukraine, Belarus, Uzbekistan, Kazahstan, Moldova and Lithuania. All or most of these facilities produced substantial amounts of excess lignin, so-called “hydrolysis lignin” (HL). In spite of the fact that there were energy utilizing boilers, they were not able to use all hydrolysis lignin for the energy production and main part of HL was stored in dumps.

Technology of energy utilization of HL, having a great potential is a production of granulated fuel. Perspective way is pelletization of HL. And combination of the preliminary torrefaction process of HL before its pelletization (isothermal heating at 250-300 °C without oxygen) of the initial HL will lead to receiving a new product with better heating values: energy yield and density. First experience of such plant in the Arkhangelsk region of the Russian Federations shows that pellets from HL has lower calorific value not lower than 21,34 MJ/kg (with W^r=6.27%; A^r=2.45%). However it is necessary to continue optimization of the granulation process to increase the mechanical strength of the final product, now it is *DU*=85.5-93.5% (mechanical strength DU characterizes the possibility of the sample to resist external mechanical influence, not being destroyed according to EN 152010-1).

Therefore a huge interest is being raised to the energy utilization of the hydrolysis lignin in the Russian Federation. For the effective energy utilization of the HL it is necessary to study deeply its characteristics, process of thermal decomposition and combustion, to analyze gas components and ashes during the process of thermal degradation, to carry out comparison with classical wood fuel (spruce, pine).

Furthermore definition of kinetic characteristic will lead to the optimization of the process of thermal degradation and combustion in heat generating equipment.