THERMAL DEGRADATION AND PHYSICAL-MECHANICAL PROPERTIES OF LIGNIN-FILLED RIGID POLYURETHANE FOAM

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Polyurethane (PU) foam is one of the most important thermal insulation materials used in the construction industry and is the main insulation material used in the global appliances (refrigerators, freezers, etc.) industry. Nowadays, the synthesis of polymers from renewable resources, including polyurethane foams, has been actively investigated.

In this work the potential application of lignin (CIMV, France) as non-reactive filler in tall oil amide (OH = 269 mg KOH/g, H_2O = 0,2 wt.%) based rigid PU foams is studied. Goal of this work was to investigate thermal and physical-mechanical properties of lignin-filled rigid PU foams.

Before lignin was introduced into rigid PU foams structure, lignin was dried and grinded with laboratory disintegrator. For foam production mixtures with different lignin content (0-30 wt. % in tall oil polyol) were made and reacted with polymeric 4,4'-diphenylmethane diisocyanate (pMDI). Mechanical testing of rigid PU foams was performed on testing machine Zwick/Roell Z100. Thermogravimetric analyses were made on machine Mettler Toledo TGA/SDTA for testing lignin content effect on thermal properties of rigid PU foams.

Rigid PU foams with density 51±3 kg/m^3 and up to 96 % of closed cells content were obtained. It was determined that compressive strength parallel to foaming direction increases in samples where the amount of lignin in tall oil polyol component is up to 5 %. Reaching the maximum value - 0,35 MPa in sample where the amount of lignin in tall oil polyol component is 5 %. By further increasing lignin content the compressive strength of rigid PU samples reduced.

Thermal degradation of lignin-filled rigid PU samples occurs in 3 main steps - ~220°C, ~330°C and ~430°C. Degradation products increase with adding lignin in foams indicating the increasing volume of coke arising from degradation products of the lignin aromatic structure.

It was concluded that introducing lignin to rigid PU foams systems can increase physico-mechanical properties of foams. Compressive strength of obtained samples meets the requirements of construction and refrigeration industry. The maximum lignin content in tall oil polyester type polyol could reach 30%, in the same time the lignin content in ready rigid PU foams reach 6,3% and renewable material content in end product up to 24 %.

Acknowledgement. *The financial support of BIOCORE project (FP-241566) by the EC through the FP7 is greatfully acknowledged.*