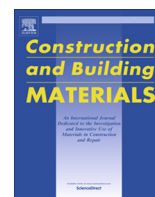




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Application of the water-insoluble pyrolysis oil fraction as an organic binder



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HIGHLIGHTS

- The water-insoluble fraction of pyrolysis oil can be used as a component of bitumen binder.
- The best properties are exhibited by a composite binder supplemented with 10–15% wiPO.
- A composite binder with an adhesive strength higher than that of both initial materials is obtained.
- Modified asphalt concrete has lower water absorption and higher strength.

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ABSTRACT

Wood fast pyrolysis oil could potentially be applied as an additive to an organic binder for use in road construction. The aim of this work was to investigate the properties of a composite binder made of bitumen and the water-insoluble fraction of wood pyrolysis oil. Pyrolysis oil was made from birch wood by fast ablative pyrolysis. Separation of the pyrolysis oil was conducted with recovery of the water-insoluble fraction of wood pyrolysis oil. A composite binder consisting of bitumen and the water-insoluble fraction of pyrolysis oil was produced. Modified asphalt concrete was made with the composite binder. The properties of the composite binder and the modified asphalt concrete were investigated. It can be concluded that the water-insoluble fraction of pyrolysis oil can be used as a component of composite bitumen binder. The best properties are exhibited by the binder supplemented with 10–15% of the water-insoluble fraction of pyrolysis oil.

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1. Introduction

Most bituminous adhesives or binders used for pavement materials are derived primarily from fossil fuels [1]. However, the reduction of fossil feedstock reserves has resulted in the desire to involve renewable feedstock in industry. Thus, the use of renewable resources and materials, including in road construction, is a significant area.

Lignocellulosic biomass is one of the largest and most widely available renewable resources on Earth [2]. Biomass processing in wood industry, agriculture and other branches results in the generation of large quantities of wastes. These wastes often remain unclaimed and require money and effort for utilization. However,

this renewable resource can be used as feedstock for the production of substitutes for fossil materials. Fast pyrolysis is one of the promising technologies to convert biomass into liquid products, which can be used as a substitute for petroleum-derived products in different applications [3].

In addition, liquid products of the thermal decomposition of lignocellulosic biomass may be applied as additives to an organic binder in road construction [4]. The application of wood thermal decomposition products in road binders and for soil strengthening has been represented in several works [5–7]. This approach is particularly relevant when involving forestry wastes and the use of local renewable materials as a binder in road construction.

The highest yield of liquid products (up to 75 wt.% [8]) can be achieved by fast pyrolysis, i.e., thermal decomposition of biopolymers in the absence of an oxidizing environment at high (up to 1000 °C/s) heating rates and low product residence times in the reaction zone [9]. Liquid products of fast pyrolysis include a

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