



EFFECT OF THE ADDITION OF CHEMICALLY DEGRADED POLY(ETHYLENE TEREPHTHALATE) ON THE RHEOLOGICAL PROPERTIES OF BITUMEN

WPŁYW DODATKU POLI(TEREFTALANU ETYLENU) PODDANEGO CHEMICZNEJ DEGRADACJI NA WŁAŚCIWOŚCI REOLOGICZNE ASFALTU

Grzegorz Mazurek*, Mateusz Kaniewski, Marcin Podsiadło
Kielce University of Technology, Poland

Abstract

The study explores the feasibility of incorporating poly(ethylene terephthalate) (PET) plastomer into processed asphalt through chemical degradation. The depolymerization process involved subjecting the PET plastomer to aminolysis reaction with ethylenediamine. Consequently, the resultant monomer exhibited reduced rigidity and increased machinability. Enhancing its degree of fragmentation facilitated improved homogenization with bitumen. The resulting blend of bitumen and degraded plastomer underwent evaluation for creep resistance in accordance with the Multiple Stress Creep Recovery (MSCR) methodology at a temperature of 64°C. Moreover, fundamental standard tests were conducted, including penetration, softening point, and Fraass breaking point. The incorporation of additional amino groups in the form of degraded PET into the bitumen reduced its susceptibility ($J_{nr3200} < 0.5 \text{ kPa}^{-1}$) to the creep process and lowered the brittle temperature (approximately -3°C) in comparison to 50/70 neat bitumen. Furthermore, the proposed depolymerization technology for PET and its application to bitumen represents a viable approach for the utilization of PET plastomer.

Keywords: plastomer aminolysis, rheology, recycling, Maxwell model

Streszczenie

W pracy przedstawiono możliwość aplikacji plastomeru poli(tereftalan etylenu) PET do asfaltu przetworzonego poprzez zastosowanie chemicznej degradacji. Proces depolimeryzacji polegał na poddaniu plastomeru PET reakcji aminolizy z wykorzystaniem etylenodiaminy. W efekcie uzyskany monomer uzyskał mniejszą sztywność oraz był łatwy w obróbce mechanicznej. Zwiększenie jego stopnia rozdrobnienia umożliwiło lepszą homogenizację z asfaltem. Uzyskaną mieszaninę asfaltu i zdegradowanego plastomeru poddano ocenie odporności na proces pełzania zgodnie z metodyką MSCR w temperaturze 64°C. Ponadto wykonano podstawowe badania normowe takie jak: penetracja, temperatura mięknięcia oraz temperatura Fraassa. Wprowadzenie dodatkowych grup aminowych w postaci zdegradowanego PET do asfaltu zmniejszyło jego podatność ($J_{nr3200} < 0,5 \text{ kPa}^{-1}$) na proces pełzania oraz temperaturę lamliwości (około -3°C) w porównaniu do asfaltu 50/70. Ponadto zaproponowana technologia depolimeryzacji PET i jego implementacja do asfaltu jest sposobem, który można wykorzystać do utylizacji plastomeru PET.

Słowa kluczowe: aminoliza plastomeru, reologia, recykling, badania asfaltu, model Maxwella

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