

The influence of non-carcinogenic petroleum-based process oils on tire compounds' performance

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Abstract High aromatic oils which have been widely used as process oils in tire the industry contain high concentrations of polycyclic aromatic hydrocarbons (PAHs). These aromatic compounds (PAHs) have proved to be carcinogenic as well as posing a threat to the environment. Since the beginning of 2010, the use of high aromatic process oils has been banned under the EU regulation 1907/2007 commonly called REACH (registration, evaluation, authorization and restriction of chemicals). The so-called regulation has given rise to challenges to the oil and tire industries in replacing high aromatic process oils with safer alternatives. In the present work, four types of low aromatic petroleum-based process oils, namely mild and high-viscosity naphthenic oils (LNAP and HNAP), treated distillate aromatic extract (TDAE) and mildly extracted solvate (MES), were investigated and their effect on plasticization and durability properties of two different low and high oil-extended tire formulations were evaluated. The compatibility of oils with rubber was investigated as well. The results showed that a number of properties such as abrasion resistance and tire rolling resistance were improved by using non-carcinogenic oils, while tire grip properties were declined. Considering oil–rubber

compatibility, TDAE and MES were found to be more compatible with rubbers.

Keywords Low aromatic oil · Tire compound · Long-term properties · Compatibility

Introduction

Plasticizers (softeners) are organic substances added to polymers to improve their flexibility and processability. They increase elongation and low-temperature flexibility and decrease the hardness, glass transition temperature, T_g of polymers and compounds viscosity due to lowering of intermolecular forces [1, 2].

High aromatic oils have been traditionally the most used process oils for tire rubbers. Their popularity is explained by their good balance of properties and lower price compared to other types of process oils. These high aromatic oils are often referred to as distillate aromatic extracts (DAEs) [3].

In 1994, the Swedish National Chemical Inspectorate (KEMI) published a report regarding the use of high aromatic extender oils in tire treads as hazardous to the health and safety of the environment. These oils contain high concentrations of polycyclic aromatic compounds (PCAs), many of which are identified as suspected carcinogens [4, 5].

Therefore, in accordance with the EU directive 1907/2007, commonly called REACH (registration, evaluation, authorization and restriction of chemicals), starting from 2010, every new tire produced in the European Union or imported there has to contain oils with low content of polycyclic aromatic hydrocarbons (PAHs) to be classified as non-carcinogenic.

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