Investigation of Chemical Transformations by NMR and GPC During the Laboratory Aging of Arabian Asphalt

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ABSTRACT

In this work the chemical properties, of a commercial grade Saudi Arabian asphalt procured from Ras Tanura refinery, were evaluated. The rolling thin film oven (RTFO), termed as short-term aging, and pressurized aging vessel (PAV), termed as long-term aging, tests were used to simulate the laboratory aging of this asphalt. It was found that PAV has more severe effects on the chemical properties of asphalt than RTFOT method. The Corbett fractionation procedure was used to separate fresh and aged asphalts into four generic fractions namely; asphaltenes, polar aromatics, naphthene aromatics, and saturates and various analytical techniques were applied to evaluate the chemical changes occurred during the aging processes. HP-GPC molecular weight and size distributions suggested that molecular rearrangement occurs predominantly on aging. Carbon and proton NMR measurements of generic fractions showed that isomerization, internal cross-linking, and dehydrogenation were the main chemical reactions of hydrocarbon groups following aging. Coupling the results from the GPC and NMR techniques have led to some interesting information concerning the chemical reaction types during the aging processes. Significant differences were observed between the structure and composition of fresh and aged generic fractions of Ras Tanura asphalt.

INTRODUCTION

The composition of asphalt has been the subject of much study because such data is required in determining its performance-related properties. A problem inherent in studying asphalt composition is its chemical complexity; however, the characterization of asphalt can better be achieved by separating into asphaltenes, maltenes, and their further fractions[1]. The structure of asphaltenes was first proposed as consisted of a central core of elementary carbon and surrounded by adsorbed resins in the form of micelles[2].

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