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Ambient air — Determination of the mass concentration of tire and road wear particles (TRWP) — Pyrolysis-GC-MS method

Air ambiant — Détermination de la concentration en masse de particules provenant de l'usure des pneumatiques et des chaussées (TRWP) — Méthode par pyrolyse-CG/SM

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Foreword

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Introduction

Tyre and road wear particles (TRWP) are formed as a result of tread abrasion from the road surface and subsequent particle release to the environment. TRWP consist of tyre tread particles which include incorporated material from the road surface.[3] The elastomeric fraction in TRWP contained in $PM_{2,5}$ or PM_{10} is quantified in this document by direct pyrolysis-GC-MS analysis of a sample filter. Mass can be expressed on the basis of the rubber polymer, tyre tread, or TRWP. This method has been used to measure the airborne concentration of TRWP in the PM_{10} fraction for three geographically separated regions.[4] The TRWP concentration in soil and sediment has also been characterized by a similar method.[5]

Specific chemical markers are generated from intact TRWP by pyrolysis of sample specimens. The chemical markers consist of characteristic and specific pyrolysis dimeric fragments of passenger and truck tyre tread polymers including butadiene rubber, styrene-butadiene rubber, and isoprene rubber. The polymer fragments generated by sample pyrolysis are subsequently separated by gas chromatography and identified by mass spectroscopy. The TRWP mass concentration is calculated based on market average polymer use rates in tread and prior characterization of the mineral content of TRWP. Rubber polymer specificity is achieved by quantification of dimeric polymer fragments consisting of two monomer units.[6][7] Repeatability is achieved by the use of a deuterated internal standard of similar polymeric structure to the tyre tread polymers. The internal standard corrects for variable analyte recovery caused by sample size, matrix effects, and temporal variation in instrument response. The method is suitable for monitoring changes in ambient air TRWP concentrations over a specified averaging time.