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MEMORANDUM

Date: 6/14/2019

To: Dr. Lam Leung, Chemours

CC: Mike Aucoin, AECOM

From: Eric Redman, Director of Technical Services

Subject: LC/MS/MS Method Performance for DFSA, MMF, MTP, and PPF Acid

This technical memorandum addresses questions regarding observed variability in the determination of 4 analytes (DFSA, MMF, MTP, and PPF Acid) by Eurofins TestAmerica's current LC/MS/MS methodology known as the 'Table 3+' analytical method.

DFSA, MMF, MTP, and PPF Acid are very small molecules by LC/MS/MS standards, consisting of just one or two fully fluorinated carbons with one or two terminal acidic moieties (carboxylic and/or sulfonic).

The size, structure, and highly polar nature of these molecules create a variety of technical challenges for LC/MS analysis. Due to the size and structure of DFSA, MMF, MTP, and PPF Acid there are relatively few characteristic mass fragments or mass transitions that can be used to identify them in the LC/MS/MS methodology, and the identification elements that exist are not unique to DFSA, MMF, MTP, and PPF Acid. These analytes are therefore prone to a large range of chemical interferences that can adversely impact the performance of the analytical method.

The small and highly polar nature of DFSA, MMF, MTP, and PPF Acid also means that these analytes are not easily retained under the usual LC/MS/MS chromatographic conditions. Poor retention in turn means that these analytes cannot be chromatographically separated or resolved from physical or chemical interferences, and are therefore more susceptible to adverse impacts from these co-eluting interferences. These can be manifest as discreet interferences that mimic the MS/MS response of DFSA, MMF, MTP, and PPF Acid and either obscure their presence (false negatives) or impart a positive bias (false positives). Additionally, non-discreet or bulk interferences such as dissolved solids, high ionic content, and naturally occurring organic and ionic compounds (humic acid or NOM) can create severe ion suppression and enhancement effects in the LC/MS/MS analysis. DFSA and MMF are further prone to variable impacts from ionic substances (including pH differences) due to their unusual di-acidic character.

The combination of multiple properties that can adversely impact analytical performance means that current 'Table 3+' analytical procedures will generate variable and potentially unreliable results for DFSA, MMF, MTP, and PPF Acid in samples. Analytical performance for DFSA, MMF, MTP, and PPF Acid has been demonstrated to be reliable in the absence of matrix interferences, but a growing body of empirical evidence including sample duplicate and matrix spike results indicates that matrix effects have a significant adverse impact in field samples.