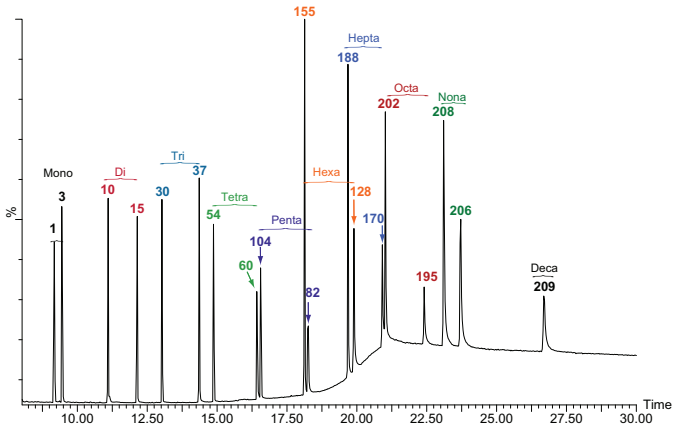
November 13, 2008

Debromination of PBDEs in the DE-83™ Technical Mix by Electrolysis

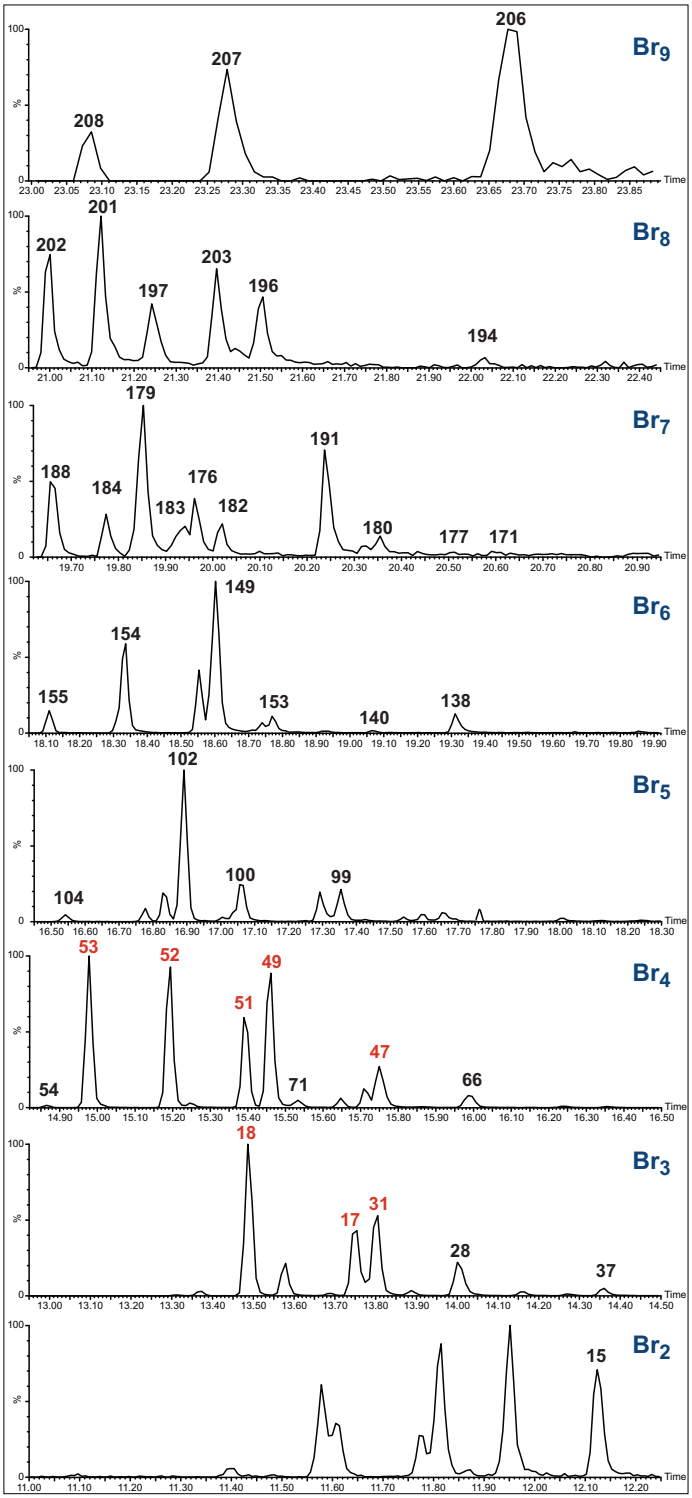
BDE-209 is the major component in DecaBDE. There is concern that degradation (through photolysis or metabolism) may produce lower brominated BDE congeners that are more toxic to environmental species and to human health. Metabolic debromination of BDEs may occur through an electron transfer mechanism.

Electrochemical reduction is by nature an electron transfer process. Hence, the objective of this work was to compare the electrochemical debromination of commercial DecaBDE (DE-83™) in the presence of water with the analogous photochemical and metabolic processes. Indeed the debrominated BDE products obtained by electrolysis are similar to those observed in the debromination of BDE 209 in rainbow trout. The electrolysis reaction mixture was monitored by HRGC/HRMS (see figure, right) with the aid of the window defining mixture BDE-WD (see figure, below).

The reaction is likely initiated by electron capture forming a radical anion, which sequentially loses a bromide ion, suffers a further reduction to the aryl anion, and then protonates. Significantly, the environmentally relevant congeners BDE-47, BDE-99, and BDE-154 do not appear to be major products of debromination of BDE-209 by an electron transfer mechanism.



Window Defining Mixture BDE-WD (IUPAC numbers)



All peaks are labelled with IUPAC numbers

BDEs in red were determined by ^{1}H NMR analysis

HRGC/HRMS analysis of the reaction after 20min of electrolysis