11th North American Waste to Energy Conference

NAWTEC11-1690

SUBSTANCE AND PERCEPTIONS OF ENVIRONMENTAL IMPACTS OF DIOXIN EMISSIONS: AN INTERIM REPORT

N.J. Themelis, and P. Deriziotis
Earth Engineering Center, Columbia University,
500 West 120th Street, New York, NY 10027, USA

Abstract
The emission of dioxins is perceived widely as a major environmental impact of combustion processes. This paper will report the results of an extensive study of published data on a) the rate of formation of dioxins from all U.S. sources; b) the pre-MACT and post-MACT performance of individual Waste-to-Energy (WTE) plants in the U.S. and how post-MACT emissions compare with the 1998 EU standard (0.1 ng/dscm); c) how the contribution of WTEs has changed with time; and d) the measured impacts of WTE dioxin emissions on soil/plant concentrations and on public health. The study has shown that since 1987 the U.S. dioxin emissions have decreased by a factor of four and by now WTEs are a miniscule source. Also, that even at the earlier high emission levels, the dioxin levels in soil samples close to WTE facilities did not exhibit an increase over regional background concentrations. Finally, the paper contrasts public perceptions of the dioxin threat with scientific studies of observed effects on the environment and on public health.

Please note: This is not a complete paper but an interim report on some of the findings of this study. The results of the study will be presented at NAWTEC 11 and a full paper will be published at a later time.

Background Information
Polychlorinated dibenzo-dioxins, dibenzo-furans and related components are some of the most rigorously studied substances in the modern epidemiology and toxicology. Of the 210 compounds identified, only 17 are considered toxic. Chemical analysis of dioxin concentrations in stack gases measures all dioxin and furan compounds in the gas. As noted above, most of these compounds are not toxic. Therefore, World Health Organization has measured the toxicity of each known dioxin and furan (about 175 different compounds) and has established toxic equivalence factors (TEF) that relate the toxicity of each compound on a scale of 0 to 1, where 1 is the most toxic dioxin known. On the basis of these factors, and the prevailing distribution of different types of dioxins and furans in the flue gas of WTE plants, EPA has established that the prevailing ratio of total to toxic dioxins is approximately 50. Accordingly, 50 grams of total D/F emissions correspond to about 1 gram of toxic equivalent (TEQ).

The toxicity of dioxins has been proven by numerous animal studies. However, the lethal dose of the most toxic compound, 2,3,7,8-TCDD, has been found to vary by more than 5000-fold between the most sensitive, and the least sensitive species [Fiedler et al. 2000]. These results have resulted in a great deal of uncertainty amongst the scientific and medical community about assessing health risks for the general public.

The chemical, biological, and physical resistance of dioxins and thus their tendency to accumulate in the environment and in organisms have forced national and international authorities to issue strict regulations. These are based on laboratory studies on animals the results of which are extrapolated to low doses for human use, applying different mathematical models. The diversity and ambiguity of the outcomes can be illustrated by the different Tolerable Daily Intake (TDI) levels imposed by various