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DIOXIN EMISSIONS FROM WOOD COMBUSTION

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ABSTRACT

The emissions of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) from combustion of different kinds of wood have been determined. Emissions from natural beech wood sticks (0.019 to 0.064 ng TE/m³), natural wood chips (0.066 to 0.214 ng TE/m³) and uncoated chipboard chips (0.024 to 0.076 ng TE/m³) were low, whereas the combustion of waste wood chips resulted in higher dioxin emissions (between 2.70 and 14.42 ng TE/m³). Additionally, two specific fuels were investigated: charcoal and household waste. Charcoal used for grilling of meat resulted in the very low PCDD/PCDF emissions of 0.028 ng TE/m³, whereas the emissions from the combustible part of household waste were very high (114 ng TE/m³). Based on the specific dioxin emissions per kg of fuel, the annual emissions from combustion of wood and the specific fuels were calculated in Switzerland to be 6.9 to 43.8 g TE.

INTRODUCTION

Combustions are major sources of emissions of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) into the environment. While many investigations have been performed to study the emissions of PCDD and PCDF from municipal waste incinerators[1-3] as well as hazardous waste incinerators[4], there are only few reports on dioxin emissions from wood combustions[7-11].
Schlatter et al. in 1989[5] as well as the Swiss Federal Office of the Environment (BUWAL) in 1991[6] published estimated data of annual emissions of PCDD/PCDF in Switzerland that are shown in table 1.
Due to absence of measured values, there has been a large uncertainty regarding dioxin emissions from wood combustion.

Table 1: Estimated annual emissions of PCDD/PCDF in Switzerland

Source	g TE/year[5]	g TE/year[6]
Municipal Waste Incineration	260 - 320	90 - 150
Hospital Waste Incineration	approx. 10	2 - 3
Hazardous Waste Incineration	2 - 6	< 1
Wood Combustion	---	<1 - 10
Motor Vehicles	4.5 - 13.5	2 - 14
Metal Industry	7 - 21	6 - 16
Paper & Pulp Industry	0.1	1 - 5
Total	280 - 370	100 - 200

The dioxin emissions of different kinds of furnaces (6 to 1800 kW power) burning various kinds of wood (natural wood, chipboards, waste wood) under favourable or less favourable combustion conditions were therefore investigated under the guidance of the Swiss Federal Office of the Environment (BUWAL). Additionally, the dioxin emissions from a household stove, grilling meat over charcoal and burning household waste were measured.

EXPERIMENTAL

Combustion furnaces: 1) household stove, open as fire-place or closed, 6 kW power, combustion chamber dimensions 44 x 37 x 34 cm; 2) stick wood boiler, cyclon combustion chamber, 35 kW power; 3) automatic wood chip furnaces: a) understoker with separate primary and secondary air supply adjusted via the boiler temperature, 110 kW power; b) preoven grate firing with separate primary and secondary air supply, 150 kW power; c) preoven grate firing with separate primary and secondary air supply, removal of waste gas particles by a cyclon, 410 kw power; d) grate firing with separate primary and secondary air supply, removal of waste gas particles by a cyclon and an additional fabric filter, 850 kW power; e) grate firing with separate primary and secondary air supply, removal of waste gas particles by a cyclon and an additional electrostatic precipitator.

Combustibles: 1) natural beech wood sticks, stored for 2 years, 12-16% humidity, 2) mixed natural wood chips, 40-60% humidity, 3) chipboard chips, 4) waste wood chips from demolition of buildings, 10-25% humidity, 5) charcoal used for grilling meat, 6) combustible part of household wastes sampled for 2 weeks in 12 households, consisting of 2/3 paper and carton and 1/3 plastics.