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LONG RANGE DISPERSION OF AIR POLLUTANTS FROM A PROPOSED INCINERATION SITE IN THE NORTH SEA

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1. BACKGROUND

The Netherlands has proposed a new incineration site in the southern North Sea, located between 54°05'N and 54°10'N, 02°40'E and 03°00'E. "The intention is based on the urgent need to locate an incineration site at a greater distance from the Netherlands coast in view of complaints of a chlorine smell above land as a possible result of the incineration operations" (1). The present site is about 30 km off the Dutch coast, the proposed site will be about 110 km off any coastline.

2. RELEASE TO THE AIR

The amount of wastes considered for incineration at the new site is 400 000 - 500 000 tons/year. The incineration capacity of the present M/T Vulcanus is 20-25 t/h. Two other ships, Matthias II and Matthias III both have a capacity of 40-70 t/h, depending on the calorific value of the waste. The flame temperature is between 1200 and 1400 °C and the combustion efficiency 99.9%. Analyses show the effluent gas to contain from 40% to 70% chlorine (2). It seems reasonable to assume 40% chlorine for a combustion rate of about 40 t/h (calorific value of 5000 kcal/kg) and close to 70% for a rate of 70 t/h (calorific value 3000 kcal/kg). Hydrogen chloride (HCl) gas is formed. The amount of other elements and toxic materials is believed to be of minor importance.

3. EFFECTS OF HYDROGEN CHLORIDE (HCl) - AIR QUALITY STANDARDS

Effects of HCl in relatively small concentrations are not well known. It contributes to corrosion and to detoriation of paint. Concentration limits are not available.

It is known that chloride from sea salt may affect forests near the coast in Norway, and that a natural selection of persistent species takes place. Effects further inland occur only occasionally and are not considered serious.

Air quality standards based on physiological effects varies. A general lowering trend is observed. From 1976 the Federal Republic of Germany gives 100 µg HCl/m^3 as arithmetic long term mean value and 200 µg HCl/m^3 as maximum half-hourly value, not to be exceeded more than 5% of the time (3). The odour limit is 50-100 µg HCl/m^3 (4).

4. ESTIMATED MAXIMUM CONCENTRATIONS

Maximum concentrations at distances of 200 km (Ekofisk oil installations) and 400 km (Norwegian SW coast) are estimated to 600 µg HCl/m^3 and 300 µg HCl/m^3 respectively, for a release of 48 t HCl/h. A mean windspeed of 5 m/s has been assumed, further that the effluents are evenly distributed vertically below a mixing height of 1200 m. The lateral diffusion is assumed to be low, in accordance with the small turbulent diffusion levels observed over the sea, when the sea temperature is lower than the air temperature (5). The stable air layer then formed also prevents deposition to the sea. In other weather conditions the maximum concentrations will be much lower. During precipitation the gas is absorbed and deposited. The assumption that a distinct plume shape is maintained for transport over hundreds of kilometres under special weather conditions is in agreement with observations of plumes in Canada (6) and Australia (7).

5. PROBABILITY OF DEPOSITION OVER NORWAY

Statistical data of wind direction and wind forces over the North Sea is scarce. Data from the weather ship Famita only covers the winter season (1959-1975). Other data used are air trajectories for the period 1972-1975 from the OECD study of "Long range transport of air pollutants" (8). A point on the coast of SW Norway will only be within the plume for 5% of the time, regardless of type of air stability and precipitation.

The long term contribution to the acidity of soil, lakes and rivers can be compared to the total contribution of sulphur dioxide gas from, for instance, the whole area of Netherlands. The OECD report state this emission to be 400 000 t SO_2/year. If a constant burning at the incineration site throughout the year is assumed, and a transport towards SW Norway 10% of the time and an average loss of 50%, then the two contributions becomes equal, the one from the site and the other from the Netherlands. The OECD report state the latter as 1-2% of the total deposition in Norway.

6. CONCLUSIONS

Concentration values of hydrogen chloride (HCl) in the air may exceed values stated in the air quality standard of the Federal Republic of Germany in special weather and dispersion conditions. However, their frequency of occurrence is far lower than the 5% allowed in the standard.

The mean contribution to the acidity of rainfall over Norway is less than 1% of the total and hence negligible.

Locally, short period depositions may become relatively high. The importance of these is uncertain.

Concentrations at oil installations in the North Sea will be higher than on the mainland, but corrosion effects of HCl concentrations are believed to become small compared to those of sea salt.

The release of HCl is equal in size to the largest SO_2 releases from smelters or power stations. The high concentrations in the plume should make it relatively easy to follow over hundreds of kilometres with an aircraft.

Since the estimated values are based on limited meteorological data and relative crude assumptions, supplementary experimental data from aircraft measurements are obviously desirable.

7. REFERENCES

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