samples and one inorganic chemical industry sample were excluded.

The organic industry and the petroleum industry by nature should have considerable volatile material in the effluent waters. Raw material feedstock plus the in-plant operation suggest this. In general, chemical processes employing small organic molecules or subjecting large molecules to reactor environments that include high temperatures, pressures, and catalyst, which form smaller molecules, will discharge water containing these substances. The wood industry should also discharge some volatile material, although the raw material and the major products are not generally volatile. The pulping process is known to produce volatile by-products. The food industry is similar to wood in some respects. The main difference is that food preparation, including cooking and blanching, involves a milder chemical reaction environment. Food water F_v° is nearly half that of the wood water median, and K_s/a values are similar. The fabrication industry deals with solids both as raw material and product, while inplant operations usually exclude chemical processing with the exception of the use of organic solvents.

Conclusions

A desorption experiment has been developed to quantify the fraction, F_v°, and the relative volatilization rate, K_s/a, of the organic matter in wastewater that can be readily desorbed into the atmosphere. Test results of 75 samples indicate that a sizable quantity of the organic material discharged by the chemical processing industry readily desorbs into the air and/or is air strippable.

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Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide

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■ Brook trout, *Salvelinus fontinalis* (Mitchill), were exposed to various concentrations of hydrogen cyanide to determine the effects of continuous exposure on survival, growth, and reproduction. Continuous flow experiments were begun with adults 144 days prior to spawning and were continued through a 90-day growth period of the second generation. The maximum acceptable toxicant concentration (MATC) of hydrogen cyanide was between 5.7 and 11.2 μg/L based on the spawning data.

Cyanide is present in many industrial and municipal wastewaters. The most important source of cyanide pollution is from the effluents of metal finishing, metallurgy, steel processing, and petroleum industries. The most common forms of cyanide are free cyanide ($HCN + CN^-$), metallocyanide complexes, and organocyanides. Free cyanide in most natural waters is predominantly in the form of HCN, which has been determined to be the most toxic cyanide form (*1*).

Few published studies contain information on acute or chronic effects of cyanide on brook trout, *Salvelinus fontinalis* (Mitchill). Karsten (*2*) reported that all of eight brook trout died within 136 h at 0.05 mg/L free cyanide as CN, and all of six survived for 27 days at 0.02 mg/L. Neil (*3*) found 0.05 mg/L free cyanide as CN to be nonlethal to brook trout exposed for 40 days, while five of 10 died after 87 h at 0.08 mg/L CN. Neil tested fish at 9.5 °C, but Karsten did not report the test temperature. Neil also found that the swimming ability of brook trout was markedly impaired by sublethal levels of free cyanide as low as 0.01 mg/L CN.

The present study was undertaken to determine the effects of continuous cyanide exposure on brook trout survival, growth, first-generation spawning, and second-generation survival and growth. In addition, a relationship between acute and chronic toxicity was determined.

Materials and Methods

Experimental Apparatus. Adult brook trout were tested in 10 fiberglass tanks (210 × 54 × 54 cm) with a 30-cm standpipe 12 cm from the downstream end. The tanks contained a volume of 340 L. Each of two head tanks fed water to four cyanide treatments and a control. Dissolved oxygen and water temperature were regulated in each head tank. The test water was from a laboratory well and was transported through polyvinyl chloride pipe and polyethylene tubing to the experiment. A complete analysis of the well water was described by Smith et al. (*4*).

A diluter system similar to that described by Brungs and Mount (*5*), but utilizing a microswitch and two magnetic drive pumps, was used to control water flow. The toxicant dispensing system was similar to the one described by Mount and Warner (*6*). The dilution system dispensed 4 L of water every 2.5 min, providing a 99% replacement time of 17 h.

The adult fish in each tank were allowed to spawn in two boxes 50 × 38 × 15 cm deep described by Benoit (*7*). Eggs were removed on the day of spawning from each spawning box and placed in incubation cups made of acrylic plastic cylinders 6.5 cm o.d. with Nitex screen bottoms. Eggs were incubated in separate diluter systems employing 20-L glass aquaria. The egg cups were oscillated in the test water by means of a rocker-arm apparatus described by Mount (*8*). Brook trout juveniles were subsequently kept in the diluter system used for egg incubation. The diluter system was similar to that described for adults, but it utilized two solenoid valves instead of magnetic pumps. A water volume of 1.35 L was dispensed every 2.5 min, and a 99% replacement occurred in 3 h.