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Demonstration Bulletin

SoilTech Anaerobic Thermal Processor: Outboard Marine Corporation Site

SoilTech ATP Systems, Inc.

Technology Description: The anaerobic thermal processor (ATP) was developed by UMATAC Industrial Processes under the sponsorship of the Alberta Oil Sands Technology and Research Authority (AOSTRA). The technology is licensed by SoilTech ATP Systems, Inc. (SoilTech), a U.S. corporation. The ATP technology uses a physical separation process to thermally desorb organics such as polychlorinated biphenyls (PCBs) from soils, sediments, and sludges. The ATP system was used to remove PCBs from contaminated soils and sediment at the Outboard Marine Corporation (OMC) site in Waukegan, IL.

The ATP system mixes and heats contaminated soils, sediments, and sludges in the processing unit. The processor consists of four separate thermal zones: the preheat, retort, combustion, and cooling zones. Figure 1 presents a sectional diagram of the processor showing the four internal zones. The unit is designed to operate at temperatures of 400 to 650 °F in the preheat zone; 900 to 1,150 °F in the retort zone; 1,200 to 1,450 °F in the combustion zone; and 500 to 800 °F in the cooling zone.

Temperatures in the preheat zone cause water and volatile organic compounds (VOC) in the waste to vaporize. Water vapor and evaporated contaminants are removed by vacuum and enter a preheat vapor cooling system, which consists of a cyclone, condenser, and three-phase preheat separator. Recovered water is sent to an onsite treatment system. Light organic vapors that are not condensed are then fed by a blower directly into the combustion zone of the processor. Condensed organic compounds are combined with condensate from the retort vapor cooling system.

Hot, granular solids exiting the preheat zone pass through a sand seal and enter the retort zone. The higher temperatures in the retort zone cause (1) heavy oils to vaporize and (2) thermal cracking of hydrocarbons, which forms coke and low molecular weight gases. Vapor from the retort zone is removed by vacuum and passes through a pair of cyclones to remove entrained particles. These dusts and fines are blended with the treated soil. The vapor is cooled by oil circulating in two packed columns; the

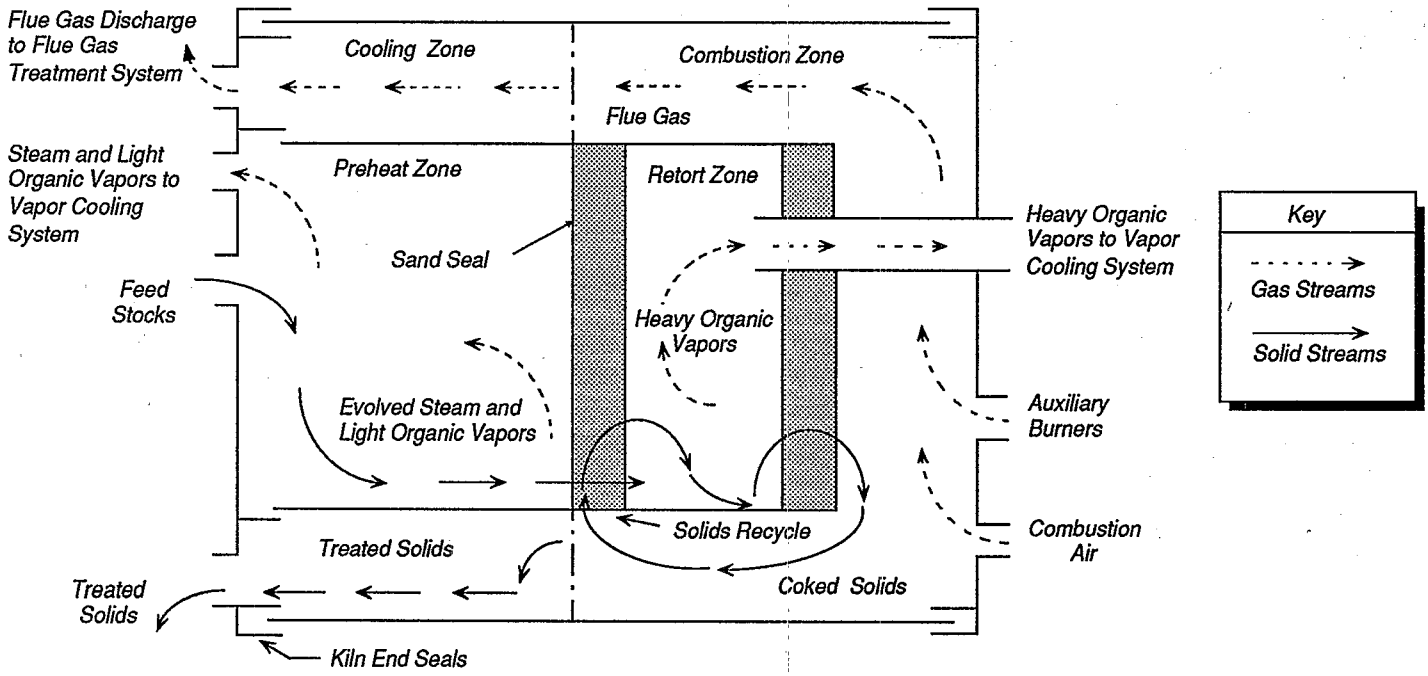

Figure 1. Simplified section diagram showing the four internal zones.

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columns act as a two-stage direct-contact condenser for compounds with high boiling points. The remaining vapors then pass through a water-cooled noncontact condenser and a three-phase separator. The remaining uncondensed gases are returned to the combustion chamber of the treatment system. The condensed oil phase is returned to the packed columns. Condensed water is pumped directly to the onsite treatment system.

The coked solids pass through a second sand seal into the combustion zone. During the OMC site remediation, sodium bicarbonate was added to the coked solids to minimize the potential for the emission of PCBs from the ATP system. In the combustion zone, the coked solids are combusted and either recycled to provide heat to the retort zone, or sent to be cooled in the cooling zone. Flue gas from the combustion zone is treated in a cyclone and baghouse to remove particles and a carbon adsorption system to remove trace organics. Treated flue gas is then discharged to the atmosphere through a stack. Treated soils exiting the cooling zone are quenched with tap water and are then transported by conveyor to an outside storage pile.

Waste Applicability: SoilTech reports the following specifications for the ATP system. The transportable ATP unit is capable of processing about 10 tons of contaminated soil or sediment per hour. The optimal moisture content of the waste to be treated is between 5% and 10% by weight. Wastes with a moisture content up to 20% can be treated, but the high moisture content will reduce net throughput rates. Wastes with a moisture content greater than 20% may need to be dewatered to optimize process economics.

The ATP system is also designed to treat wastes with a nominal hydrocarbon concentration of 10%. The ATP is capable of treating wastes containing contaminants with a wide range of boiling points. Heavy oil contaminants have been reduced from as high as 60% in the untreated waste to near detection limits in treated solids.

Demonstration Results: In June 1992, the ATP technology was demonstrated during full-scale remediation of the OMC site in Waukegan, IL. Three replicate test runs were conducted at the typical operating conditions used during the OMC site remediation. Each test run consisted of 8.5 hours of solids and liquids sampling and 8 hours of stack sampling. A total of 224 tons of PCB-contaminated soil and sediment was treated in the SoilTech ATP during the SITE demonstration. Extensive process operating data were collected during the demonstration to document the operating conditions of the ATP process.

Key findings from the OMC site demonstration include the following:

- PCB concentrations were reduced from an average of 9,761 parts per million (ppm) in the untreated soil and sediment to an average concentration of 2 ppm in the treated soil and sediment.
- Approximately 0.12 milligrams (mg) of PCBs were discharged from the ATP system's stack per kilogram of PCBs fed to the ATP.
- The majority of PCBs removed from the untreated soil and sediment were accumulated in the waste oil discharge from the vapor cooling system.
- No dioxins, other than a low concentration [0.1 nanograms (ng) per dry standard cubic meter (dscm)] of octachlorinated dibenzo-p-dioxin in one stack gas sample, were detected in the stack gas from the ATP system. Tetrachlorinated dibenzofurans were found in both the untreated soil and sediment (88 ng/g) and treated soil and sediment (5 ng/g), and the stack gas (0.07 ng/dscm).
- Leachable VOCs, semivolatile organic compounds, and metals in the treated soil and sediment were below Resource Conservation and Recovery Act toxicity characteristic standards.
- No operational problems affecting the ATP's ability to treat the contaminated soil and sediment were observed.

An Applications Analysis Report and a Technology Evaluation Report describing the complete SoilTech ATP SITE demonstration will be available in the Spring of 1993.

For Further Information:

EPA Project Manager:
Paul R. dePercin
U.S. EPA Risk Reduction Engineering Laboratory
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7797

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

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