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Project Summary

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units

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This project was initiated to provide an evaluation of the effectiveness of existing treatment technology for upgrading steel mill wastewaters to Best Available Technology (BAT) Economically Achievable limits for Blast Furnace Category scrubber wastewaters. The wastewater tested was a blast furnace effluent from an operating steel mill treatment system that met 1977 Effluent Guidelines for Best Practical Control Technology (BPT) Currently Available. This wastewater contained residual concentrations of suspended solids, BOD, oils and greases, phenols, cyanides, fluorides, ammonia compounds, sulfides, and dissolved solids. The in-depth pilot plant study was performed using mobile facilities designed especially for treating steel plant wastes.

Treatment processes evaluated during the study included: alkaline chlorination, chemical treatment, dual media filtration, magnetic filtration, reverse osmosis, ozonation and activated carbon.

Based on the performance results of the pilot program, it was concluded that the physical/chemical technology investigated (alkaline chlorination, ozonation, and reverse osmosis) was effective in reducing influent blast furnace scrubber wastewater contaminants to below BAT levels. Evaluation and comparison of the treatment train capital and operating costs determine that alkaline chlorination was the least-cost alternative. The study also concluded that significantly less space was required for the treatment train utilizing ozonation than for treatment trains involving alkaline chlorination or reverse osmosis.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In 1972, the Federal Water Pollution Control Act (PL92-500) was enacted by the U.S. Congress. The Act directed the U.S. Environmental Protection Agency (U.S. EPA) to develop effluent limitation guidelines for all major industrial groups, among them the steel industry. EPA was also mandated to recommend appropriate levels of treatment and estimate costs to meet the proposed limitations. As part of its overall mission, the EPA's Industrial Environmental Research Laboratory of Research Triangle Park, NC, funded this study to determine the feasibility of treating steel plant wastewater to Best Available Technology (BAT) Economically Achievable levels. This particular project was concerned with the treatment of blast furnace scrubber blowdown wastewater.

The project objective was achieved through the performance of a program consisting of the three phases outlined below:

PHASE I - Bench Scale Investigations of a Blast Furnace Scrubber Blowdown Wastewater.

PHASE II - Design and Fabrication of the Mobile Treatment Facilities to House the Pilot Scale Equipment.

PHASE III - Operation and Evaluation of the Advanced Waste Treatment Pilot Plant Systems at a Blast Furnace Site.

The purpose of the first phase (bench-scale work) was to provide information concerning the treatment methods to be studied for the Phase II design and the Phase III pilot plant investigation (operation and evaluation). Of particular interest were such items as the pretreatment requirements, magnitude of operating variables, expected magnitude of treatment efficiency and effluent quality, selection of equipment and media, and pilot plant system design.

The second phase objective (System Design and Fabrication) was to provide a mobile pilot testing system for evaluating several advanced waste treatment technologies. The portable treatment system developed included the technology needed to remove the residual contaminants from the blast furnace BPT wastewater to the extent that this wastewater was upgraded to meet BAT requirements as proposed in 1974. Schematic representations of the mobile testing systems are shown in Figures 1 and 2. Trailer No. 1 housed the alkaline chlorination, chemical treatment, magnetic filtration, and dual media filtration systems. The ozonator, activated carbon, and reverse osmosis technologies were located in Trailer No. 2. The mobile system contained a high degree of automation which greatly assisted the operators during the study. All of the treatment technologies were designed to treat a nominal flow of 18.9 l/min (5 gpm).

The advanced waste treatment methods, both singularly and in combination, investigated on a pilot basis in Phase III, included the following:

1. FIL + O + CT
2. ACL + CT + AC
3. CT + FIL + RO + O (on ROB)
4. CT + FIL + RO + ACL (on ROB)

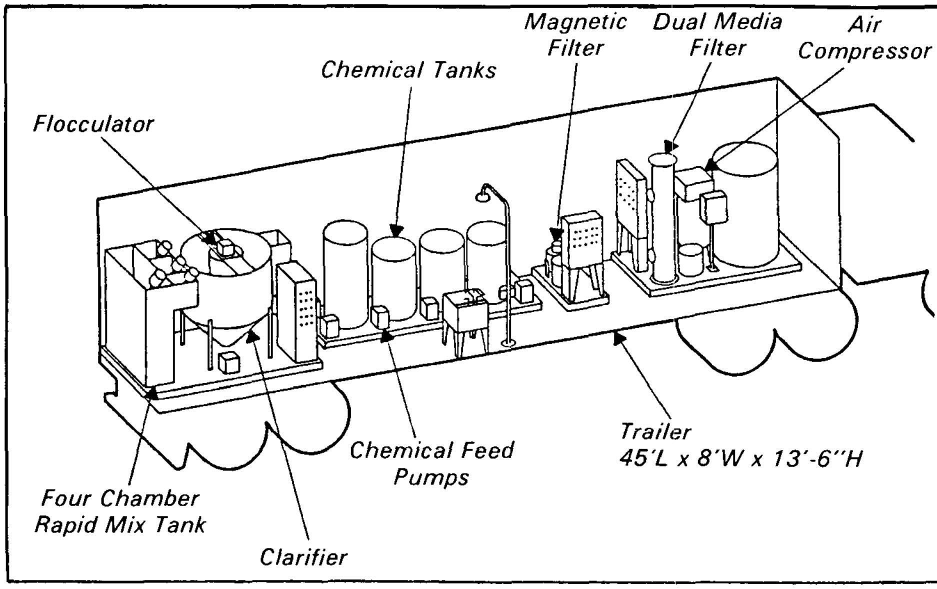

Figure 1. *Steel plant mobile treatment system-trailer No. 1.*

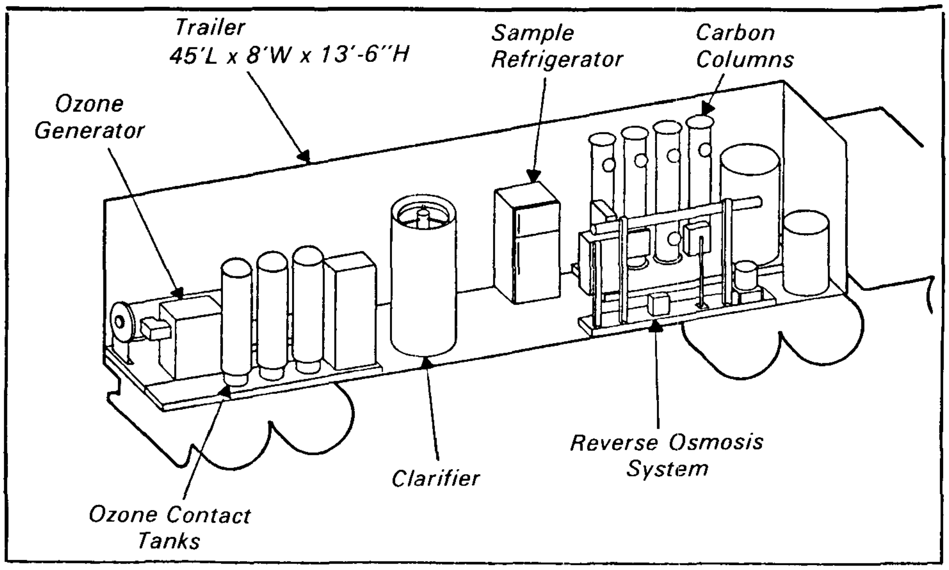

Figure 2. *Steel plant mobile treatment system-trailer No. 2.*

Key

AC: activated carbon
ACL: alkaline chlorination
CT: chemical treatment
FIL: filtration-dual media or magnetic
O: ozonation
RO: reverse osmosis
ROB: reverse osmosis brine

A schematic illustration of the process trains investigated for treatment of the blast furnace wastewater is shown in Figure 3.

For each treatment train investigated, samples and operational data were obtained for later use in assessing, evaluating, appraising, and comparing the adequacy of the individual advanced waste treatment methods.

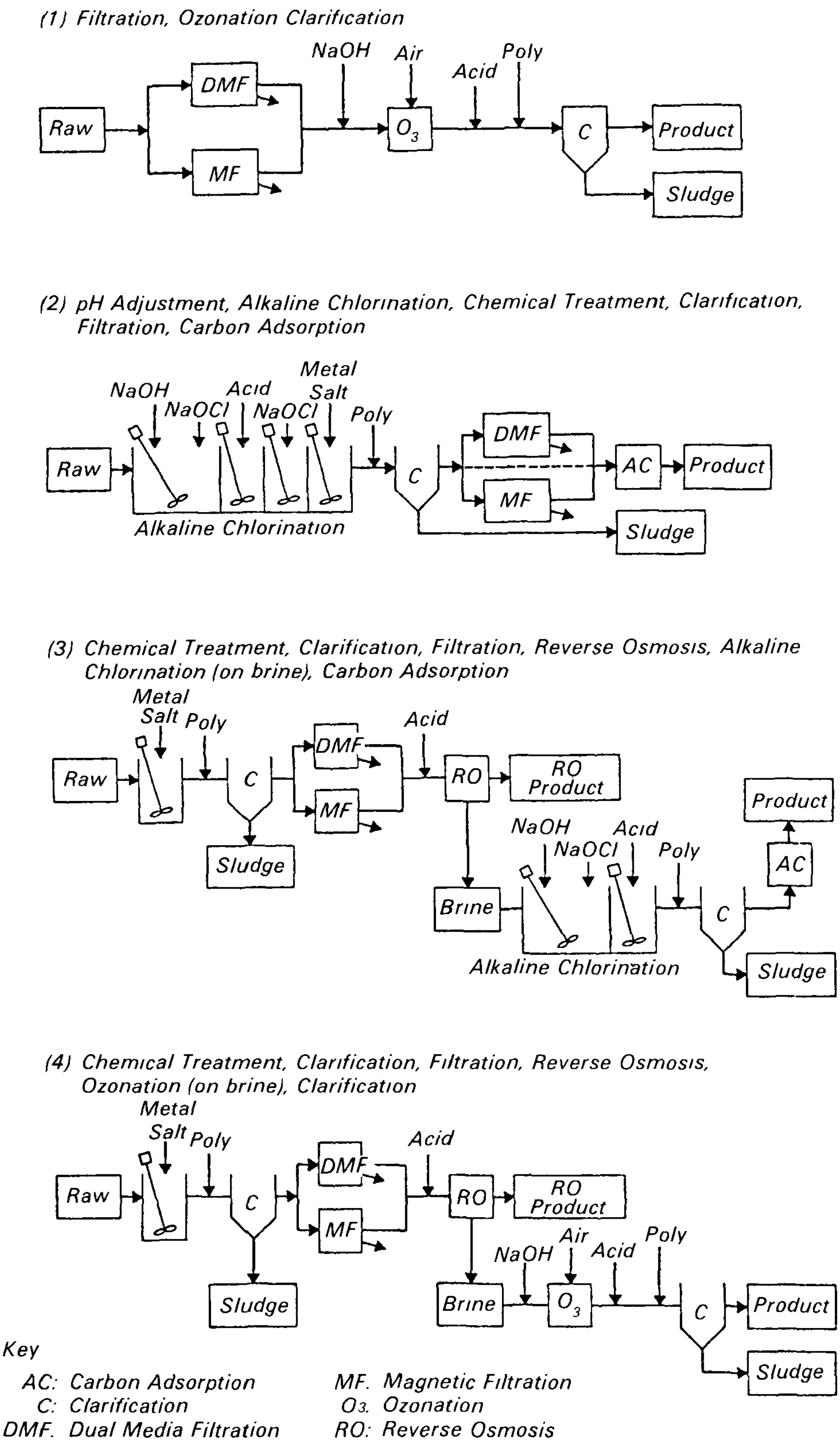

Figure 3. *Process trains investigated for treatment of the blast furnace wastewater.*

Conclusions

This report was concerned with the investigation and evaluation of the effectiveness of selected physical/chemical treatment technology on Blast Furnace category scrubber wastewaters. Effectiveness was measured using the criteria: performance, costs and space requirements. Physical/chemical treatment technology investigated included: chlorination, ozonation, reverse osmosis, chemical treatment, clarification, activated carbon, and filtration. General conclusions from this pilot scale investigation are listed below:

1 The results of the pilot program indicated that alkaline chlorination, ozonation, and reverse osmosis were effective in reducing influent contaminants to below BAT levels in the treatment of blast furnace scrubber blowdown.
   a. Pretreatment requirements.
      1. For alkaline chlorination none
      2. For reverse osmosis: chemical clarification and filtration
      3. For ozonation. filtration
   b. Post-treatment requirements
      1 For alkaline chlorination chemical clarification and possibly activated carbon. The activated carbon might be required where free chlorine discharge limitations are in effect. Other methods of chlorine removal were not investigated.
      2. For reverse osmosis: brine treatment by alkaline chlorination or ozonation.
         (a) Following alkaline chlorination of the reverse osmosis brine, the wastewater would require clarification with polymer and dechlorination by activated carbon (where dechlorination is required prior to discharge).
         (b) After reverse osmosis brine treatment by ozonation, clarification with polymer is required.
2. Alkaline chlorination was the least-cost alternative treatment train investigated Expected capital investment for a 5,678 m^3/day (1.5 mgd) train is $1,171,300. Th

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corresponding operating costs including amortization of capital are estimated at $2 68/3,785 liters ($2.68/1,000 gal.).

3. Ozonation has the lowest system area requirement of 676 m^2 (7,100 ft^2). This compared to 938 m^2 (10,100 ft^2) for the alkaline chlorination treatment train.
4. The three treatment trains investigated (alkaline chlorination, ozonation, and reverse osmosis) were all able to reduce the priority pollutant to metals to 10 μg/l except for zinc and selenium. BIS-(2 ethylhexl) phthalate (BEP) was the only organic reported above the 10 μg/l verification limit.

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The complete report, entitled "Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units," (Order No. PB 81-159 386; Cost: $24.50, subject to change) will be available only from:

National Technical Information Service
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