United States
Environmental Protection
Agency

Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

Research and Development

EPA-600/S9-83-016 Dec. 1983

EPA

Project Summary

Proceedings: Symposium on Iron and Steel Pollution Abatement Technology for 1982

Franklin A. Ayer

This document summarizes presentations at the Symposium on Iron and Steel Pollution Abatement Technology for 1982, the fourth in this series, in Pittsburgh on November 16-18, 1982. It provided a forum for the exchange of information on technological problems related to multimedia pollution control in the iron and steel industry.

American and international representatives from industry, academia, the research community, public interest organizations, and Federal and state governments participated in the symposium. The opening session dealt with cost reduction, rational decision-making in technological development, alternatives to confrontation between the industry and environmentalists, a geographic approach to integrated environmental management, and a panel on environmental trade-offs. Subsequent sessions dealt with other aspects of solid waste, air and water pollution abatement. In all, 186 people participated in the symposium.

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).

The Symposium on Iron and Steel Pollution Abatement Technology for 1982, the fourth in this series, is the first to be conducted with the cosponsorship of the American Iron and Steel Institute and with support from the Iron and Steel Committee of the Air Pollution Control Association.

The symposium was held in Pittsburgh, PA, on November 16-18, 1982. It provided a forum for the exchange of information on technological problems related to multimedia, solid waste, air, and water pollution control in the iron and steel industry.

Summaries or abstracts of speakers remarks follow:

Opening Session

Richard D. Stern, Chairman
Industrial Environmental
Research Laboratory
U.S. EPA, Research Triangle Park,
NC 27711

Stern called the symposium to order, welcomed the participants, and introduced Robert C. McCrillis, U.S. EPA, IERL-RTP, and Earle F. Young, Jr., AISI, Washington, DC, General Chairmen.

Statement of Symposium Objectives

Robert C. McCrillis, Symposium
General Chairman
Industrial Environmental
Research Laboratory
U.S. EPA, Research Triangle
Park, NC 27711

McCrillis informed the participants that this fourth symposium on iron and steel pollution abatement technology is the first of this series to be cosponsored by the American Iron and Steel Institute with support from the Iron and Steel Committee of the Air Pollution Control Association. He emphasized that the objective of the symposium is to focus on

technological solutions to environmental problems and that the speakers represent a wide cross section of industry, government, and contractor viewpoints. He further stated that cost-effective minimization of total environmental impact should be the ultimate goal.

Reducing the Cost of Air Pollution Control in the Iron and Steel Industry

Peter N. Bibko (Regional Administrator) and David L. Arnold (Environmental Engineer) (Presented by Stanley Laskowski)
U.S. EPA, Region 3
Philadelphia, PA 19106

The goal of the EPA's regulatory reform efforts is to facilitate the use of more effective, less costly control measures while ensuring a cleaner environment. The reforms in the air programs are known as Emissions Trading and include the bubble policy, offset policy, and emission reduction banking. Of these reforms, the bubble policy has become the most well known and publicized program. At a time of rising control costs and shrinking resources, the policy can speed both economic growth and continued progress toward clean air. For the iron and steel industry, the policy offers increased flexibility, less government intrusion in the corporate planning process, and savings of millions of dollars in annual control costs. For the environmental community, it should result in more air quality progress than additional direct regulation. For the economic development community, it can facilitate the revitalization of existing plants. This paper briefly discusses what the policy is and how it can be used and describes three bubble projects which were developed by iron and steel companies in Region 3.

Rational Decisionmaking in Technology Development

William L. West, Director
Environmental Control
Republic Steel Corporation
Cleveland, OH 44101

Environmental control programs in the U.S. appear to be based on an ever-increasing demand for more stringent technology. This trend should be examined for its necessity in relation to environmental goals and benefits. The underlying legislative and administrative policies should be modified when such modification can be accommodated without jeopardizing environmental goals.

Environmentalists vs. The Steel Producers; Are There Alternatives to Confrontation?

W.I. Goldburg, President, GASP, and Professor, Department of Physics and Astronomy, University of Pittsburgh
Pittsburgh, PA 15260

Mutual distrust between environmentalists, steel company management, and regulatory agencies may unnecessarily impede the solution to the nation's pollution problems. Experiences in Allegheny County provide the basis for some suggestions aimed at reducing this distrust.

The Geographic Approach to Integrated Environmental Management

Michael R. Alford, Chief
Geographic Unit
Integrated Environmental Management Program
U.S. EPA, Washington, DC 20460

EPA and its counterparts at the state and local levels have historically attacked pollution problems by establishing separate programs for each of the three environmental media — air, water, and solid waste — and have required polluters to reduce their impacts through specified control technologies. This approach has resulted in substantial progress toward national environmental quality goals. It now appears appropriate, however, to supplement this traditional focus with other integrative mechanisms, in order to move toward the solution of the remaining problems. The fact that our control strategies do not simultaneously address all media has led to control efforts that may be less effective and more costly than they might have been.

The Integrated Environmental Management Program (IEMP) in EPA's Office of Policy Analysis is developing methods to help solve emerging environmental problems in a more cost-effective manner. IEMP is now working on methodologies for integrating controls on an industry basis, by examining environmental problems and controls as they relate to specific industrial sectors. The other mechanism under study in IEMP, the geographic approach to program integration, is the subject of this paper.

Panel: Environmental Trade-offs

Michael R. Alford, Chairman
U.S. EPA, Washington, DC 20460

Stanley L. Laskowski, William L. West, and Walter I. Goldburg, Panel Members

This panel discussion was not recorded.

Session 1. Multimedia Pollution Abatement

Michael R. Alford, Chairman
U.S. EPA
Washington, DC 20460

Joseph G. Crist, Chairman
U.S. Steel Corporation
Monroeville, PA 15146

Mission and Research Programs of the Industrial Waste Elimination Research Center

James W. Patterson
Illinois Institute of Technology
Chicago, IL 60616

The Industrial Waste Elimination Research Center (IWERC) was established in 1980 at Illinois Institute of Technology, under the sponsorship of the U.S. EPA Centers of Excellence program. The Center, operated by IIT in consortium with the University of Notre Dame, is concerned with fundamental research directed toward the avoidance, abatement, or elimination of the generation of air, water, and solid pollutants. The Center, now in its second full year of operation, is supporting five major research projects. This paper discusses the mission and objectives of the Center and presents research objectives and results.

Chromium Removal Mechanisms for Waste Management of a Specialty Steel Mill

Virginia M. Cusano and Robert H. Wills, Jr.
Crucible, Inc.
Syracuse, NY 13201

The Resource Conservation and Recovery Act along with recent rounds State Pollution Discharge Eliminatic

System permits reflecting the application of Best Available Technology Economically Achievable have significantly increased costs for transportation, treatment, and disposal of both solid and liquid wastes. In addition, the New York State Superfund places an assessment on certain wastes.

Crucible Specialty Metals Division in Syracuse, NY, has been involved in various resource recovery projects since 1975. These projects include: (1) investigation of the effectiveness of an abandoned alkaline wastebed to absorb and retain chrome and other heavy metals present in steel mill wastes; (2) a method of detoxification of hazardous air pollution baghouse dusts by transferring soluble chrome from the solid phase to the liquid phase for recycle or treatment; and (3) reuse of waste acid, from pickling operations, as the primary coagulant at Crucible's industrial wastewater treatment plant.

Landfilling Solid Wastes from Specialty Steel Production on a Solvay Process Wastebed

J.A. Hagarman, R.W. Klippel
Calocerinos & Spina
Liverpool, NY 13088

R.H. Wills, Jr.
Crucible, Inc.
Syracuse, NY 13201

For the past 8 years, Crucible, Inc., Specialty Metals Division, in Syracuse, NY, has been landfilling solid wastes from production of specialty steels on an abandoned Solvay Process wastebed adjacent to Onondaga Lake.

The hydrogeology and geochemistry of the site, as well as the leaching chemistry of landfilled solid wastes, have been studied intensively over the past several years in order to define potential problems such as contamination of areal groundwater and surface water and impacts on the local biological community.

The results of these studies show that the Crucible landfill does not pollute either ground or surface waters and has no harmful effects on biota. Studies of Electric Arc Furnace (EAF) and Argon-Oxygen Decarburization (AOD) dusts indicate a high leaching potential for toxic hexavalent chromium (Cr). Detailed studies of the interaction of hexavalent Cr leached from EAF and AOD dusts and the Solvay Process waste underlying the landfill show that two attenuation mechanisms immobilize the hexavalent Cr in the underlying Solvay Process waste.

Particulate and Particle Size Data for Clean and Contaminated Quench Water Usage — Dofasco No. 1 Wet Coke Quench Tower

John D. Jeffery
GCA Corporation/Technology Division
Bedford, MA 01730

A measurement program was developed in cooperation with EPA's Stationary Source Compliance Division (OAQPS/SSCD), EPA's Industrial Environmental Research Laboratory (ORD/IERL-RTP), Dominion Foundries and Steel Company, Ltd. (Dofasco), and the Munters Company to sample emissions from the No. 1 wet coke quench tower at Dofasco's facility in Hamilton, Ontario. The tower, its location, baffle design, and availability of both clean and contaminated water for quenching were selected to answer questions for the cosponsors. Briefly, these questions are: Can a tower, equipped with a multiple directional baffle array located in the upper two-thirds of the tower with an exit velocity less than 20 fps, achieve lower emission rates than towers previously tested? What removal efficiency can be achieved? What will the particle size distribution be?

The program sampling was devised to measure particulate matter and particle size distribution above and below the baffle array simultaneously. The tower was sampled during normal operations with quench water at 501 mg/l and later with by-product flushing liquor at 8850 mg/l TDS. Composite water samples were taken from the quench water header line, the return trough, and the varying makeup supply lines for each particulate test conducted to determine the effect of water quality on emissions. Process observations were recorded pertaining to battery operations, coal-coke conditions, and the operation of the quench tower itself.

Session 2. Solid Waste Pollution Abatement

Penelope Hansen, Chairman
U.S. EPA
Washington, DC 20460

David G. Boltz, Chairman
Bethlehem Steel Corporation
Bethlehem, PA 18016

Groundwater Monitoring Strategies for Steel Industry Residue Disposal Operations

Andrew P. Pajak and David W. Hupe
Michael Baker, Jr., Inc.
Beaver, PA 15009

Regulations issued by the U.S. EPA and state regulatory agencies require that owners or operators of existing and new surface impoundment, landfill, or land treatment hazardous waste management facilities implement a groundwater monitoring program. Moreover, evolving nonhazardous waste regulations are including groundwater monitoring and protection requirements. RCRA hazardous waste regulations published on July 26, 1982, are significantly different than previously imposed regulations. This paper highlights the new regulatory approach and differences between the existing and new federal RCRA regulations, especially in the area of flexibility and variances. Design of an acceptable monitoring network and protocol are discussed. Problems experienced in monitoring network design and interpretation of resulting data are illustrated. Concise flowcharts of actions required by the regulations and an outline for designing a groundwater monitoring program are provided.

Recovery of Metallic Values from Electric Arc Furnace Steelmaking Dusts

E. Radha Krishnan and William F. Kemner
PEDCo Environmental, Inc.
Cincinnati, OH 45246

Dust generated from electric arc furnaces (EAFs) used in steel plants is currently listed as a hazardous waste. Disposal of the waste at a controlled landfill is becoming costly as disposal sites become scarcer and more distant from the point of origin. The dust, however, represents a potential source of metals such as iron, zinc, lead, chromium, nickel and molybdenum; recovery or recycling of these metals appears to be a logical alternative to the disposal problem. This paper presents a technical and economic assessment of various technologies available for recovery of metallic values from EAF steelmaking dust.

The type of recovery process which can be employed depends on the chemical composition of the EAF dust, which in turn is dependent on the type of steel

product being made. Carbon and low alloy steel EAF dusts are rich in zinc and lead, while dusts from stainless and specialty alloy steels contain significant quantities of chromium, nickel, and molybdenum. Five recovery processes are discussed in this paper: 1) a caustic leach electrolytic zinc recovery process studied in a pilot plant by AMAX Base Metals Research and Development, Inc., in Carteret, NJ; 2) the Waelz kiln practice for processing EAF dusts which is being commercially employed by the New Jersey Zinc Company, Inc., in Palmerton, PA; 3) an electrothermic shaft furnace process using plasma heat piloted by SKF Steel Engineering in Sweden and currently being commercialized; 4) a commercial pyrometallurgical smelting technique developed by Inmetco in Ellwood City, PA; and 5) a recycling process perfected by the U.S. Bureau of Mines in coordination with Joslyn Stainless Steel Division in Fort Wayne, IN.

The AMAX and New Jersey Zinc processes are applicable to recovery of heavy metals, such as zinc and lead, from carbon steel EAF dusts. The SKF process can be applied to both carbon steel and specialty steel dusts to recover metals such as iron, zinc, lead, chromium, and nickel. The Inmetco and Bureau of Mines processes are suited to recovery of iron and alloying elements from stainless steel EAF dusts.

Mill Scale De-oiling by Critical-fluid Extraction

Thomas J. Cody, Jr., Richard P. de Filippi, and Christopher P. Eppig
Critical Fluid Systems, Inc.
Cambridge, MA 02140

A process for de-oiling mill scale with critical-fluid solvents (liquefied gases or supercritical fluids) has been successful in bench-scale tests. A process design and evaluation has been completed, and preliminary economic estimates for both capital and operating costs appear promising. Additional testing for final process definition is expected to be concluded in several months.

Session 3. Air Pollution Abatement

Murray Greenfield, Chairman
Dofasco, Inc.
Hamilton, Ontario, Canada L8N 3J5

James R. Zwikl, Chairman
Shenango, Inc.
Pittsburgh, PA 15255

Determination of the Decay in Control Efficiency of Chemical Dust Suppressants on Unpaved Roads

Thomas Cuscino, Jr., Gregory E. Muleski, and Chatten Cowherd, Jr.
Midwest Research Institute
Kansas City, MO 64110

This paper presents the methodology and results of two field studies directed toward the quantification of control efficiency of chemical dust suppressants applied to unpaved roads. Three generic categories of chemical controls were studied: water, a water-based petroleum resin, and a water-based asphalt emulsion. For each dust suppressant studied, the decay in control efficiency with time (or more specifically, with vehicle passes) is presented for a single application intensity, dilution ratio, and vehicle weight and speed distribution. Separate control efficiency curves for total, inhalable, and fine particulate emissions are presented.

It was observed that there is a more than linear increase in control efficiency with an increase in chemical suppressant concentration in the applied liquid. It was also observed that the increased shear stress on the treated road caused by stop-and-go traffic results in a much more rapid decay in control efficiency than occurs with constant speed traffic. Finally, it is concluded that a single control efficiency value for a chemical dust suppressant is a meaningless value unless the associated vehicle, road, and chemical application (and reapplication) characteristics are specified.

The Effect of Dust Control Measures in a Dutch Iron and Steel Works

Cornelis A. Aronds
Hoovogens IJmuiden
IJmuiden, Netherlands

At the expense of large investments and exploitation costs, Hoogovens has achieved a considerable reduction of its dust emission from process sources. A measuring network was installed around the works to assess the effect of this reduction on the quality of the ambient air. Instruments according to the U.S. EPA high volume sampler (HVS) method and the directives of the West German "Landesanstalt für Immissionsschutz (LIB)" were used in parallel for comparison of the results.

Notwithstanding the reduction in the emission, no significant decrease in particulate concentrations could be found. After correction for the large influence of several weather factors and the contribution of other sources, a better agreement with expectations could be obtained, especially with the German method. One of the reasons is that the German method is less sensitive to coarse dust in the air, meaning it is independent of the wind speed. Moreover, this method has some other advantages.

Fugitive Dust Emissions from Roads in Iron and Steel Mills: Compilation of Results and Use Under EPA's Emission Trading Policy

L.L. Simmons, C.. Norton, and M.J. DeBiase
Energy & Environmental Management, Inc.
Murrysville, PA 15668

An emissions trade of fugitive particulate matter from open-dust sources for process fugitives can be accomplished through a structured approach to quantification of the emission reduction credit. Emission factors for open-dust sources can be used as a first approximation of the emissions. However, field data have shown that the average measured emission factors differ by a multiple of 0.90 for paved roads and 4.44 for unpaved roads as compared to predicted values. An exposure profiler test is recommended to quantify the emissions under current and proposed controls as part of an emissions trading application.

This information will be useful to environmental control personnel at iron and steel mills and the regulatory agencies in providing a good first order estimate of total uncontrolled anc controlled fugitive emissions from roads

A Comparison of Alternative Coke Pushing Emission Control Systems

Daniel J. Metzger and Nona L. Hancock
National Engineers and Associates
St. Louis, MO 63105

The need to control emissions evolved during the pushing of coke from a coke oven has given rise to a variety of control systems. This paper compares three of the most popular systems in use today: Mobile Systems, Traveling Hood Systems, and Coke-sided Shed Systems.

The comparisons made in this analysis are those associated with the kinds of choices facing the end user. The content of this paper is, therefore, directed toward the engineering and physical aspects of the systems.

The data presented is based on three of the systems available from National Engineers and Associates. Capital, operating, maintenance, and other related costs of the three systems may vary from systems engineered and erected by others.

All three of the coke pushing emission control systems which are the subjects of this comparison have been successfully applied to meet the regulatory requirements. As with many air pollution control tactics, the regulatory requirements have evolved and changed over time. For this reason, an understanding of the basic strengths and limitations of each type of control system is of importance to both the public and private sectors involved in control of air contaminants.

The Precision of Visual Emission Observations Within an Integrated Steel Works

D.E. Splitstone and J.Y. Lin
United States Steel Corporation
Monroeville, PA 15146

Visual observation of "smoke" is probably one of the oldest measures of source emissions. Attempts to quantify this measure have proceeded from the use of the "Ringelmann Chart" to the certification of an observer's ability to quantify source emissions in 5 percent increments of opacity. Many regulatory and source-emission standards today are based on the ability of observers to quantify visual emissions. However, analysis of data for the simultaneous observation, under actual field conditions, of various source types by several certified observers reveals that there is significant variability among the observers' perception of the opacity of source emissions. This variability is a significant portion of the precision of the measurement method. This precision is shown to vary with the diffusivity of the smoke emission, ranging from 3.6 percent opacity for well-defined emissions to 6.7 percent opacity for more diffuse emissions.

The precision of this measurement method should be taken into account when determining possible violations of applicable opacity standards. Better still, these standards should be stated in such a manner as to explicitly recognize the precision of this measurement method as part of a criterion for compliance determination.

The Relationship Between Visual-Emission Observations and Continuous-Emission Monitor Measurements of Coke-Battery Stacks

D.E. Splitstone
United States Steel Corporation
Monroeville, PA 15146

B.C. Erickson
United States Steel Corporation
Provo, UT 84601

Under current regulations, the accepted means for enforcement of opacity-emission standards is the trained certified observer. The procedure for observer certification requires that a candidate demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes generated by a smoke generator. The reference standard for this demonstration is a smoke meter or continuous-emission monitor (CEM) within the stack of the smoke generator. Therefore, it might be expected that a good and consistent relationship would be found between visual-emission observations (VEO) and CEM readings in the field.

However, in the present study extensive analysis of data collected on coke-oven-battery stacks equipped with CEMs revealed that: (1) although a correlation exists between VEO and CEM readings in the general sense, VEO readings tend to increase or decrease when CEM readings increase or decrease; and (2) no consistent relationship exists for predicting VEO readings from CEM readings. This is particularly, and most importantly, the case for high CEM readings. Therefore, the CEM readings cannot be used as a surrogate measure of visual-emission opacity for coke-oven-battery stacks.

Benzene Emissions Sources and Emissions Control at Coke By-product Plants

Leslie L. Beck
U.S. EPA
Research Triangle Park, NC
27711

C. Clark Allen and David W. Coy
Research Triangle Institute
Research Triangle Park, NC
27709

Benzene emissions are of concern at coke oven by-product plants due to benzene's carcinogenic potential. Major emission sources in by-product recovery plants are open or partially closed process vessels. This paper describes the emission factors, the relative significance of specific process sources, and air pollution control technology to reduce these benzene emissions.

Blast Furnace Casthouse Emission Control Without Evacuation

S. Vajda
Jones & Laughlin Steel
Corporation
Pittsburgh, PA 15227

During the past 3 years, J&L has developed an innovative proprietary technique for the control of blast furnace casthouse emissions. The technology, known as the Passive Emission Control (PEC) system, has been tested on three different J&L blast furnaces and was successful in complying with the opacity requirements of three states. Compliance was achieved without the use of fans and air cleaners. For the typical U.S. furnace, certain additional benefits are available: (1) lower capital cost for installation, (2) the casthouse working conditions are better than those obtained with canopy-hood or total evacuation, (3) increased iron yield, and (4) increased iron temperature. The system has been accepted by the U.S. EPA and at least five states.

Critical Review of Electric Arc Furnace Particulate Emissions Control Technology

Jaffer Mohiuddin
Pacific Environmental Services, Inc.
Vienna, VA 22180

There has been tremendous growth in the use of electric arc furnaces (EAFs) for

the production of steel in the last two decades. In 1962, 9,013,000 tons of steel was produced using EAFs. In 1980 this figure was 27,662,400 tons and in 1981, EAFs accounted for 30,137,600 tons of steel. The increase in EAF steel by 1987 is expected to be about 5 million tons. In 1976 shipments of iron castings and steel castings totaled 15.3 million tons and 1.8 million tons, respectively. It is anticipated that these numbers will increase substantially in the near future. It appears that the contribution of EAF will continue to grow. This growth is due to the fact that EAFs offer certain advantages that are not offered by other types of furnaces. These include the ability to produce all known grades of steel, the ability to use scrap steel, and flexibility of operation. They can be targeted to local markets and scrap supplies. Along with these advantages, EAFs are known to be significant producers of particulate matter emissions.

Currently, the systems that are used in controlling EAF particulate emissions include roof hoods, direct shell evacuation (DSE) systems, and side draft extraction systems for primary emissions. The secondary emissions are controlled by several techniques including canopy hoods and total building evacuation. In the recent past, several facilities have installed total furnace enclosure systems for the control of charging and tapping emissions. For the newer furnaces, there is a discernible trend toward employing total furnace enclosures due to several advantages. Furnace enclosures require air volumes 30-40 percent of that required by an efficient canopy hood, considerably reducing both capital and operating costs for duct work, fans, and gas cleaning systems.

Several specially designed "close capture" systems are also in use in both foundry and steelmaking operations. These include the Hawley close capture hood, Brusa closed charging system, Armco tapping pit system, and steam emission suppression systems. In addition, there are other designs being tested, including the Marchand design.

This paper reviews publicly available data on existing as well as emerging control technologies applicable to EAFs and their efficiency. A comparison of these control methodologies in terms of their capture efficiency and their relative cost-effectiveness will be made. Particular emphasis will be placed on identifying developing trends and their applicability to relative cost-effective EAF particulate emissions control.

Session 4. Water Pollution Abatement

John S. Ruppersberger, Chairman
Industrial Environmental Research Laboratory, U.S. EPA,
Research Triangle Park, NC 27711

S. Charles Caruso, Chairman
Mellon Institute
Pittsburgh, PA 15213

Development of a Rotating Biological Contactor for the Removal of Ammonia from Blast-furnace Recycle-water Blowdown

K.C. Krupinski and P.H. Damon
United States Steel Corporation
Monroeville, PA 15146

Proposed Federal regulations have established effluent contaminant limitations on discharges from blast-furnace gas-cleaning recycle-water systems. To meet the proposed limits for ammonia, the major contaminant, the blowdown from these systems may require treatment. As a part of the development of alternative processes for the discharge-water treatment, a supported-growth biological method for the oxidation of ammonia was investigated. An extensive program with a pilot, rotating biological contactor was conducted for about 1 year at the U.S. Steel Lorain-Cuyahoga Works in Lorain, OH. The pilot unit contained commercial-sized 12-ft diameter disks and was operated over a wide range of influent water conditions, with ammonia-nitrogen concentrations averaging 329 mg/l. Reductions in ammonia-nitrogen concentrations to 1 mg/l were achieved with the process demonstrating excellent resistance to simulated failure conditions along with the potential for low maintenance and a low level of operator attention.

Blast Furnace - Recycle System Side Stream Softening Summary of Full Scale Trial

Leonard D. Wisniewski and
Richard L. Nemeth
Republic Steel Corporation
Cleveland, OH 44101

Republic Steel's Cleveland District has undertaken a program to reduce blast furnace recycle system blowdown to volume levels that can either achieve regulatory requirements or be disposed of via quenching and evaporation on blast furnace slag. This is a potential alternate to the treatment of blast furnace blowdown using alkaline-chlorination treatment. It will be necessary to remove scale forming constituents from the recirculating waters to prevent harmful buildup throughout the recycle system as the cycling is increased. Republic is attempting to accomplish this by investigating the effectiveness of "side-stream" softening a portion of the total recycle volume.

This paper details the results of the work conducted to date on a trial softening program at its 5 & 6 Blast Furnace Recycle System at the Cleveland District steelmaking facility. Included is a description of the modified treatment system and a summary of the water chemistry softening results. A summary which compares the system's discharge loads to the recently promulgated Best Available Technology (BAT) effluent limitation guidelines is also included. This paper is a follow-up to a presentation, made by the same authors at last year's symposium, which dealt with efforts to minimize Cleveland's 5 & 6 Blast Furnace recycle system blowndown rate to below BAT levels.

Costs of Pre-treatment of Coke-plant Effluents

J. Ganczarczyk
University of Toronto
Toronto, Ontario, Canada M5S 1A4

M. Kelleher
MacLaren Engineers Inc.
Toronto, Ontario, Canada
M5E 1E7

One of the most common strategies fo pre-treatment of coke-plant effluent consists of wastewater equalization followed by ammonia stripping. Dissolve air flotation is a compact pre-treatmer method which is worthy of consideratio for some applications. The capital an operating costs, and some technologic aspects of each of these three operatior are examined in this paper.

Equalization, which is practiced i many plants and is always strong advised prior to biological treatment, associated with capital cost which vari linearly with the chosen detention perio The operating costs are minimal. It expected that adequate equalizati periods permit some cyanide conversic good oil and tar removal, and other agi phenomena which could make t

wastewater more amenable to biological treatment. Where equalization precedes ammonia stripping, oil removal improves the effectiveness of the free leg of the still.

Dissolved air flotation removes most of the oil and tar and a portion of the COD bearing material from coke plant wastewater. Although it does not perform the function of equalization, dissolved air flotation can be considered for effective oil and tar removal if the space required for adequate equalization is not available. It has relatively low capital costs and low operating costs.

In comparison to the other pretreatment methods discussed, ammonia stripping is associated with relatively high capital and operating costs. Removal of lime solids prior to the fixed leg of a conventional still considerably reduces operating costs and improves the efficiency of the unit. Many new ammonia stripping operations used caustic soda for alkaline pH adjustment because of the numerous operating problems associated with the use of lime. However, the operating costs of modified lime systems are less than those of caustic systems for comparable ammonia removal results.

Treatment of Coke Plant Wastewater With or Without Blast Furnace Blowdown Water in a Two-stage Biological Fluidized-Bed System

S.G. Nutt
Canviro Consultants Ltd.
Kitchener, Ont., Canada N2H 5M5

H. Melcer
Environment Canada
Burlington, Ont., Canada L7R 4A6

I.J. Marvan
Dearborn Environmental
Consulting Services
Mississauga, Ont., Canada
L5A 3T5

P.M. Sutton
Dorr-Oliver Inc.
Stamford, CT 06904

Pilot-scale treatability studies conducted at Environment Canada's Wastewater Technology Centre have demonstrated that the two-stage biological fluidized bed is an effective high-rate system for treatment of coke plant wastewater alone and in combination with blast furnace blowdown water. Greater than 90 percent removal of total nitrogen from undiluted coke plant wastewater was achieved at a total system HRT of 16 hours. A similar degree of treatment of a combined wastewater containing coke plant wastewater and blast furnace blowdown water was achieved at a total system HRT of 4.5 hours. In both cases, removal of conventional contaminants including FOC, phenolic compounds, and CNS approached or exceeded 90 percent consistently.

Capital costs associated with treatment of 4950 $m^3 \cdot d^{-1}$ (1.31 x 10^6 U.S. gpd) of combined wastewater were essentially identical to capital costs associated with treatment of 1300 $m^3 \cdot d^{-1}$ (0.34 x 10^6 U.S. gpd) of coke plant wastewater. Although annual direct operating costs for treatment of the combined wastewater exceeded those related to coke plant wastewater treatment by approximately $100,000, on a unit cost basis ($ per m^3 treated) operating costs for treatment of the combined wastewater were less than half those estimated for treatment of coke plant wastewater alone.

Physical/Chemical Treatment of Coke Plant Wastewaters

James R. Zwikl and
Nicholas S. Buchko
Shenango, Inc.
Pittsburgh, PA 15225

David R. Junkins
Roy F. Weston, Inc.
West Chester, PA 19380

A physical/chemical wastewater treatment facility consisting of activated carbon followed by alkaline chlorination was placed in operation at the coke plant of Shenango, Inc., in September 1979. This paper discusses the plant design characteristics, the operating experiences encountered with the activated carbon and alkaline chlorination portions of the plant, and the effects of inflation and chemical availability on the operating costs of the facility. In addition, the current performance of the plant is compared with the recently promulgated Best Practicable Technology (BPT), Best Available Technology (BAT), and Best Conventional Technology (BCT) effluent limitation guidelines for cokemaking facilities. Finally, a brief discussion is presented on the ability of the system to remove priority pollutants.

Nitrification Kinetics as Influenced by Coke Plant Wastewaters

Ronald D. Neufeld and
Jeffrey H. Greenfield
University of Pittsburgh
Pittsburgh, PA 15261

The overall objective of this research is to conduct basic studies into possible causes of biological nitrification process instability as often observed in steel industry wastewaters and, in a longer term, to propose rational and pragmatic process and operational alternatives for nitrification in two- and one-sludge combined systems. The experimental approach taken to date is to evaluate the influence of elevated free ammonia levels, pH, elevated temperatures, cyanides, and certain trace organics that tend to pass through the carbonaceous reactor zone on the kinetic parameters that quantify nitrification. Theoretical calculations based on laboratory defined parameters are made which yield suggestions as to allowable concentrations of trace inhibitors, and operational strategies for stable nitrification of coke plant wastewaters.

Effective Operation and Maintenance Practices for Wastewater Treatment Systems in the Iron and Steel Industry

William F. Kemner and
Richard T. Price
PEDCo Environmental, Inc.
Cincinnati, OH 45246

This paper presents some of the results of a current study of operating and maintenance (O&M) practices for wastewater treatment systems in the iron and steel industry. The purpose of the study is to document effective O&M practices and how their application might affect permit parameters and operational upsets. The ultimate goal of the study, which is funded by EPA's IERL-RTP, is to produce an O&M report that will assist both agency inspectors and plant personnel.

The wastewater generating processes selected for study were by-product cokemaking, ironmaking (blast furnaces), steelmaking (basic oxygen furnaces), hot forming, and acid pickling. Selections were based on pollutant loadings, system complexity, control costs, and commonality among the majority of integrated steel mills.

Information was gathered from several sources: a literature search for wastewater-related O&M practices in the iron and steel industry, discussions with state and regional agency personnel to identify major areas of concern and effective

☆U. S. GOVERNMENT PRINTING OFFICE: 1983/759-102/0801

O&M practices, review of agency files, discussions with wastewater treatment equipment vendors, and discussions with industry representatives.

Various steel mills were visited, and treatment plant operators and environmental staff members were interviewed. The information produced by these visits includes typically encountered problems and their solutions, troubleshooting efforts, extent of operator training, efforts to minimize the effect of operational upsets, and preventive maintenance practices.

The study will culminate in the preparation of a report intended to provide a better understanding of wastewater problems in the iron and steel industry, to help Agency inspectors to be more effective in evaluating the effect of O&M practices on wastewater treatment performance, and to provide information that will assist plant personnel in practical and cost-effective fine-tuning of their systems.

Franklin A. Ayer is with Research Triangle Institute, Research Triangle Park, NC 27709.

***Robert C. McCrillis** is the EPA Project Officer (see below).*

The complete report, entitled "Proceedings: Symposium on Iron and Steel Pollution Abatement Technology for 1982," (Order No. PB 83-258 665; Cost: $29.50, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Industrial Environmental Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Official Business
Penalty for Private Use $300