ESTABLISH A MUNICIPAL MINE DEMONSTRATION PLANT

HEARING

BEFORE THE

SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

NINETY-SECOND CONGRESS

SECOND SESSION

ON

S. 2556

A BILL TO ESTABLISH A MUNICIPAL MINE DEMONSTRATION PLANT, AND FOR OTHER PURPOSES

JULY 26, 1972

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ESTABLISH A MUNICIPAL MINE DEMONSTRATION PLANT

WEDNESDAY, JULY 26, 1972

U.S. SENATE,
SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS,
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 11 a.m., in room 3110, New Senate Office Building, the Honorable Frank E. Moss, presiding.

Present: Senator Moss.

Also present: Mary Jane Due, staff counsel and Charles Cook, minority counsel.

Senator Moss. The hearing will come to order.

We are pleased to be able to hold this hearing today. The subcommittee has been granted permission to hold this hearing because of the urgency of the matter and because we had scheduled this hearing in May and it had to be set over.

We are hearing today, S. 2556, a bill which was introduced by Senator Allott, which would establish a municipal mine demonstration plant.

This legislation was initiated in response to policy objectives enunciated in the Mining and Minerals Policy Act of 1970 which emphasized the need for reclamation of metals and minerals to help assure satisfaction of industrial security and environmental needs.

It is the goal of the Congress to do all in its power to conserve our rapidly diminishing resource reserves and to encourage private efforts in this area as well.

In accordance with that goal, S. 2556 will provide industry with a substantial source of resource materials through the reclamation of materials from incinerator wastes. In addition, it would create an opportunity for private parties interested in the commercial development of similar facilities by providing technical assistance and advice.

At this point in the record, I will order that the bill be printed, together with the reports and communications that we have received on the bill.

(The documents referred to follow:)

92D CONGRESS
1ST SESSION

S. 2556

IN THE SENATE OF THE UNITED STATES

SEPTEMBER 21, 1971

Mr. ALLOTT introduced the following bill; which was read twice and referred to the Committee on Interior and Insular Affairs

A BILL

To establish a municipal mine demonstration plant, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) the Congress finds that—

(1) in accordance with the policy as established by the Mining and Minerals Policy Act of 1970, the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs, is in the national interest;

(2) in order to promote the wise and efficient use of our natural and reclaimable mineral resources, re-

search, and demonstration of methods to reclaim and reuse metals and other mineral products is essential to help assure satisfaction of industrial, security, and environmental needs;

(3) in view of the Nation's prodigious consumption of metals and mineral products, every potential source must be examined, evaluated, and, if economically and environmentally feasible, developed to meet the needs of industry and national security;

(4) great quantities of mineral commodities are wasted each year and, in turn, are causing environmental degradation;

(5) the objective of wise and efficient use of our natural resources would be materially aided if such wasted mineral commodities were recovered and reused in the industrial productive processes;

(6) the residue of municipal and other large incinerators represents an extensive mineral resource that is presently not utilized, and that it is in the national interest that such resources be recovered and beneficiated for the use of the consumer and industry;

(7) the Bureau of Mines has developed, on a pilot plant scale, a method, utilizing existing mineral processing and beneficiation technology and equipment, for the recovery and separation of mineral commodities acceptable for commercial use; and

(8) while the economics appear to be highly favorable in the pilot plant stage, it is in the national interest that the technology and the economics of the pilot plant be proven by the construction and operation of a commercial sized demonstration plant.

(b) It is therefore the policy of the Federal Government to bring this technology to commercial development as quickly as possible by authorizing the Secretary of the Interior to construct a demonstration plant of commercial size and to enter into such agreements as are necessary and appropriate to insure its proper operation and the demonstration of its commercial applicability to interested persons.

SEC. 2. (a) On the basis of the findings and the policy of the Congress as set forth in the first section of this Act, the Secretary of the Interior (hereinafter referred to as the "Secretary") is authorized to enter into an agreement or other arrangement with any State or political subdivision of a State pursuant to which the Secretary shall design, construct, and equip, on land made available by such State or subdivision, a full-scale, commercial-size facility to reclaim, recycle, and process metal and mineral values contained in municipal incinerator residues and raw refuse.

(b) Any such agreement shall further provide, among other things, that—

(1) on the completion of such facility, the State or

political subdivision entering into such agreement or other arrangement shall operate and maintain such facility for the purpose of reclaiming, recycling, and processing metal and mineral values contained in municipal incinerator residues and raw refuse;

(2) such State or political subdivision will make available, by license or otherwise, on a nonexclusive royalty-free basis without territorial limitation the use of any patent obtained by such State or political subdivision under any law of the United States or any foreign country for or with respect to any invention made in the performance of any activity conducted pursuant to any such agreement or arrangement;

(3) such State or political subdivision shall make available to the Secretary all reports, plans, cost, and operating data acquired by it in connection with the operation and maintenance of such facility, together with such other detailed data, drawings, and other information of value as the Secretary may require;

(4) such State or political subdivision shall assure the right of the Secretary to utilize such facility in connection with the testing and demonstrating of new advanced techniques involving the reclaiming, recycling, or processing of metal and mineral values contained in incinerator residues and raw refuse; and

(5) such State or political subdivision will assure

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that such facility will be open, at reasonable times and consistent with safety, or inspection by interested parties.

SEC. 3. (a) Any such agreement or other arrangement entered into pursuant to section 2 of this Act shall provide for a plan of repayment, within a period of not more than thirty years from the date the principal benefits of the facility first becomes available, by the State or political subdivision entering into such agreement or arrangement to the United States of all amounts expended by the United States in connection with the designing, constructing, and equipping of such facility, together with interest thereon in such amount as shall be determined by the Secretary of the Treasury, as of the beginning of the fiscal year in which such agreement or arrangement is entered into, on the basis of the computed average interest payable by the Treasury upon its outstanding marketable public obligations, which are neither due nor callable for redemption for fifteen years from date of issue, and by adjusting such average rate to the nearest one-eighth of 1 per centum. All moneys received in connection with such repayment shall be deposited in the Treasury of the United States as miscellaneous receipts.

(b) Upon the completion of such repayment, the Secretary shall transfer all right, title and interest of the United States in and to such facility to such State or political subdivision.

SEC. 4. The Secretary shall, by publication, make available, from time to time, to any party interested in the commercial development of any facility comparable to that authorized by this Act any reports, plans, specifications, cost, and operating data, drawings, and other information of value acquired by him in connection with the construction (including designing), operation, and maintenance of the facility authorized by this Act. Such publication shall be in sufficient detail so that independent engineering and economic judgments can be made based on such publication.

SEC. 5. In carrying out his duties under this Act, the Secretary is authorized to enter into contracts, leases, or other arrangements, and to conduct research and development in connection with the carrying out of such duties.

SEC. 6. (a) For the purpose of designing, constructing, and equipping the commercial facility authorized by this Act, there is authorized to be appropriated the sum of $2,000,000.

(b) For the purpose of enabling the Secretary to carry out his duties relating to research and publication in connection with such commercial facility authorized by this Act, there is authorized to be appropriated the sum of $1,000,000.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., July 25, 1972.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: This responds to your request for the views of this Department on S. 2556, a bill "To establish a municipal mine demonstration plant, and for other purposes."

This bill would authorize the Secretary of the Interior, in partnership with a State or political subdivision therein, to build on donated land a commercial-size demonstration plant to be operated and maintained by the non-Federal partner. The proposed facility would separate and recover for commercial use metal and mineral values contained in municipal incinerator residues and raw refuse. Federal expenditures for the project are to be repaid with interest by the non-Federal partner within 30 years of the time the principal benefits of the plant first become available. Upon repayment, ownership is transferred to the non-Federal partner. This repayment provision was contained in the bill for the purpose of demonstrating, in addition to the technical feasibility of the system, the feasibility of financing such a project through conventional means (e.g. 30 year municipal bonds). The bill would authorize $2 million to build the plant and $1 million for research and publications relating to the project.

In meeting the responsibilities inherent in the Bureau of Mines' Organic Act, the Department has been active in reclaiming values from byproducts of mineral, metal, and energy processes for more than 60 years and, with the passage of the Solid Waste Disposal Act of 1965, as amended by the Resource Recovery Act of 1970, the Department was able to expand its research program in separating, recovering and recycling the values contained in a variety of metal, mineral, and energy laden solid wastes. The Mining and Minerals Policy Act of 1970 (P.L. 91-631) should ultimately clarify Federal responsibilities in the solid waste field. This Act directs the Secretary of the Interior, in the interest of national policy, to implement, among other things, programs directed toward solid waste issues in addition to problems of primary mineral and fuel supply. These programs include the reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs, research, including the use and recycling of scrap and the study and development of methods for disposal, control and reclamation of mineral waste products, as well as others.

This Department has developed programs to perfect effective solid waste management systems including extracting, processing, and reusing the metal, mineral, and energy values from a variety of urban, industrial and mineral-related solid wastes. The Department's College Park, Maryland, pilot plant operates a highly successful process which treats municipal incinerator residues by separating heterogeneous mixtures of metals and minerals into metallic iron concentrates, clean nonferrous composites, clear and colored glass fractions and fine carbonaceous ash. All of these components can be reprocessed and reused in various forms. Typical of potential products are structural bricks and insulation glass wool produced from the waste glass fractions. The iron and nonferrous metals can be refined and made available to secondary metal processors.

S. 2556 proposes that the Department continue its recycling work by expanding current research and pilot operations into a demonstration program based on the present Department model. We fully support the goals of this legislation. However, in light of the action currently underway by the Environmental Protection Agency evaluating proposals from municipalities to construct and operate resource recovery plants for processing urban refuse, we feel that passage of S. 2556 may be unnecessary. EPA, in a letter to the Office of Management and Budget, reports that of the eight applications selected in the first round cut, three of the eight are based on MBM technologies. Although it is no absolute assurance that one of the successful grantees will use MBM technology, EPA states that chances are good that at least one of the MBM systems will, in fact, be funded. In such an instance, the Department will work closely with the municipality in an advisory capacity in order to determine optimum operating conditions for the process necessary to encourage States and their political subdivisions, as well as private industry, to utilize the process.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely yours,

HOLLIS M. DOLE,
Assistant Secretary of the Interior.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., July 25, 1972.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your request of September 23, 1971, for the views of the Office of Management and Budget on S. 2556, a bill "To establish a municipal mine demonstration plant, and for other purposes."

The Office of Management and Budget concurs in the views of the Department of the Interior in its report on S. 2556, and accordingly recommends against enactment of the bill.

Sincerely,

WILFRED H. ROMMEL,
Assistant Director for Legislative Reference.

AMERICAN MINING CONGRESS,
Washington, D.C., May 11, 1972.

Hon. FRANK E. MOSS,
Chairman, Subcommittee on Minerals, Materials and Fuels, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: The American Mining Congress, a national trade association whose membership is composed of U.S. companies that produce most of the nation's metals, coal, and industrial and agricultural minerals, wishes to express its support for S. 2556, a bill that would establish a municipal mine demonstration plant.

The American Mining Congress strongly supported the concepts contained in the Mining and Minerals Policy Act of 1970. One of these concepts is that it be the continuing policy of the federal government in the national interest to foster and encourage private enterprise in mining, mineral and metallurgical research including use and recycling of mineral wastes to promote the wise and efficient use of both our natural and reclaimable resources.

Minerals and the products derived from them are the foundation of this country's strength. Many are critical to the national security. The United States consumes almost one-third of the world's minerals; therefore all potential sources must be evaluated carefully if we are to continue to meet increasing demands. In many cases reclaimed mineral wastes form an important increment of the raw material mix used in processing and manufacturing.

If the present rate of mineral consumption continues to accelerate as projected, the United States has real cause for concern since the easily accessible and minable resources are now being mined and most reserves will be depleted. New technology is needed to aid mineral discovery, production, and processing as well as the utilization of the large quantities of mineral commodities that are wasted.

Rising demand and increased competition for the world's mineral resources have resulted in a shift of capital investment into foreign sources of supply. This requires development of technologies that will enable us to mine deposits that are presently marginal and the utmost utilization of those resources.

The Department of the Interior's first annual report under the Mining and Minerals Policy Act of 1970 frequently emphasizes the importance of the reclamation of mineral wastes as a significant increment of our growing mineral demands.

The Interior report pointed out that in 1971 domestic demand for minerals amounted to four billion tons valued at $42 billion dollars. This demand was satisfied from the following sources:

Domestic Production $30 billion (approximately 2.850 billion tons)
Foreign Imports $10 billion (approximately 905 million tons)
Recycled Scrap $2 billion (approximately 190 million tons)

Recycled materials accounted for 5 percent of the domestic demand.

Anticipating the mineral demand for the year 2000, Interior calculates that the domestic demand for minerals will be 11 billion tons valued at $117 billion. It is estimated that domestic production of minerals can satisfy only 45.3 percent of that demand, valued at $53 billion. The deficit, amounting to $64 billion, would have to be made up by exports and recycled materials. If the same proportions maintain then as existed in 1971, these needs will require 550 million tons of recycled materials, valued at $5,830,000,000.

Experts feel that the materials for recycling will be available; the problem will be in providing for facilities with which the recovery can be accomplished.

It is most important that methods be developed that will update and improve recovery systems that will reduce mineral losses as well as reduce the volume of waste mineral products. Methods which the Bureau of Mines has developed for recovery and separation of mineral commodities from residue of municipal incinerators appear promising and construction of a commercial-sized demonstration plant is in order.

We appreciate the opportunity to bring these views to your attention and to urge favorable Committee and Senate action on S. 2556.

Sincerely,

J. ALLEN OVERTON, Jr., *President.*

Senator Moss. At this point, also, I will place in the record, a statement prepared by Senator Allott which he had hoped to be able to deliver personally this morning, but because of other commitments, he is unable to be here. His statement will be placed in the record in full.

Senator Allott refers in his statement to some requests that have been made for grants from the Environmental Protection Agency. Following the Senator's statement, I will print in the record, a letter that has been sent to Mr. Charles Cook, minority counsel, by Samuel Hay, Jr., Deputy Assistant Administrator for Solid Waste Management of EPA and attached to that letter is a list of applications that have been made for demonstration grants, indicating that there is some activity already in this field.

(The material referred to follows:)

STATEMENT OF HON. GORDON ALLOTT, A U.S. SENATOR FROM THE STATE OF COLORADO

Mr. Chairman, the measure before the subcommittee this morning is one of particular interest to me. As you know, Mr. Chairman, since you are not only a cosponsor of this measure but also a cosponsor of the Mining and Minerals Policy Act of 1970, recycling and reclaiming of mineral commodities was a significant factor and expectation when this Committee unanimously approved the Mining and Minerals Policy. One of the objectives of the Mining and Minerals Policy is to promote ". . . the orderly and economic development of domestic mineral resources reserves and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs."

The objective of S. 2556 is to help make available to our industry a significant source of metal and other mineral commodities by reclaiming them from incinerator residue.

In addition, the objectives of this bill are in consonance with objective No. 3 as contained in clause 3 of section 2 of the Mining and Minerals Policy Act of 1970, which is as follows:

> Mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the wise and efficient use of our natural and reclaimable mineral resources.

The "wise and efficient use of our natural and reclaimable mineral resources" requires us to look to all sources for the minerals and mineral commodities needed for our industry and consumers. Substantial quantities of iron, glass, aluminum, brass, copper, and other metals are being lost each year to residue

burial grounds. The recovery of these commodities would have a substantial and continuing impact upon the supply domestically, and would be a step in the direction of "the wise and efficient use of our natural and reclaimable mineral resources."

The Bureau of Mines has been doing some exciting work in the field of reclaiming mineral commodities, and some of it has been done at their College Park, Maryland, facility. At that facility, the Bureau of Mines has put together a process for the separation and treatment of the incinerator residue utilizing mineral processing and beneficiation equipment commonly in use by the mining industry and without the necessity of any special or specially designed equipment. The success of this process lies largely in its use of proven and accepted methods and of the use of equipment which can be practically "brought off the shelf". The Bureau of Mines has demonstrated in its College Park pilot plant that by sequencing the various processing of the residue a substantial quantity of salable product can be extracted. Approximately 24 percent of the residue can be recovered and separated into salable commodities.

Of even greater interest are the economics. Based upon projections from its thousand-pound-per-hour pilot plant, the Bureau estimates that operating costs for an incinerator of a 250-ton-per-day capacity are approximately $4.06 per ton of residue. This is on an 8-hour operating day. These costs diminish to $1.08 per ton of residue in an incinerator having a capacity of 1,000 tons per day. Inclusive in these costs are supplies, replacements, maintenance, utilities, labor overhead costs, insurance, and depreciation of the plant on a 20-year life basis.

With those operating costs in mind, the significance of the economics is that the product value is $15.76 per ton of residue. In other words, a spread of $11.70 per ton is realized when comparing the operating costs of $4.06 per ton against the commodity value of $15.76 per ton on a 250-ton-per-day plant. The spread on a 1,000-ton-per-day plant is increased to nearly $13 per ton due to reduced operating costs.

Consequently, such a plant should operate at a net profit of between $11 and $13 per ton, and this does not take into account the reduction in disposal costs for the residue as it is presently disposed of. Such a profit to the municipality or other political subdivision operating the incinerator, could be used to reduce the cost of refuse collection.

Our witnesses this morning will, I am sure, provide the Committee with more detailed information regarding the economics of the Bureau of Mines process.

Mr. Chairman, perhaps the most significant aspect of the Bureau of Mines process is that it builds upon processes and equipment already in existence. As I mentioned earlier, the processing and separating equipment utilized are a common usage by the minerals industry, and can practically be bought "off the shelf". But, more importantly, this system would utilize existing trash gathering and incinerating equipment and methods. The only change would be in the handling and disposal of the incinerator residue. Instead of being buried, and therefore lost, it would be reclaimed and made available for further beneficial use. The difficulty with many other mineral reclaiming methods is that the waste to be recycled requires special handling beginning at the point it is discarded. This includes hauling the discarded material by individual citizens to collection depots. Obviously, such methods can never be more than just partially successful. Such methods can and do work in industrial situations where large amounts of waste can be economically pre-sorted. But, municipal waste presents a different problem, and the bill before us is designed to deal with that problem.

The bill also injects two new elements into the area of waste disposal and pollution control, namely, profit and repayment of a Federal investment.

The profit aspect has already been mentioned, and, of course, it is the purpose of this authorization to prove the economics of the process on a large-scale plant.

The repayment aspect is a familiar one to members of this Committee, since the repayment plan and interest to be charged are similar to the formula commonly used on water reclamation projects regularly handled by this Committee. The bill provides for repayment within 30 years from the date the principal benefits become available with interest, at a rate comparable to the formula of the 1958 Water Supply Act. This repayment feature is unique, since other solid waste programs simply provide for grants—grants as high as 75% of the cost.

It is my belief, that if the economics of this process prove out, financing from other than Federal sources will be possible and even likely. Municipalities can

move ahead on their own without the necessity of applying for a Federal grant, and awaiting approval and availability of funds. A recognition of this possibility has apparently already stirred-up some bureaucratic back-lash. The fear that State and local governments might sever the umbilical cord of the Federal bureaucracy has caused some bureaucrats to react by opposing this legislation. I believe the Committee will find little merit in such opposition.

Mr. Chairman, I look forward to the testimony we are to receive this morning. I believe it will be both interesting and instructive.

I ask unanimous consent that an article entitled "A search for 'Gold' in Our Mountains of Trash", appearing in the Denver Post on May 7, 1972, written by me, be printed in the Record at this point.

The repayment aspect is a familiar one to members of this Committee, since the repayment plan and interest to be charged are similar to the formula commonly used on water reclamation projects regularly handled by this Committee. The bill provides for repayment within 30 years from the date the principal benefits become available with interest, at a rate comparable to the formula of the 1958 Water Supply Act. This repayment feature is unique, since other solid waste programs simply provide for grants—grants as high as 75% of the cost.

It is my belief, that if the economics of this process prove out, financing from other than Federal sources will be possible and even likely. Municipalities can move ahead on their own without the necessity of applying for a Federal grant, and awaiting approval and availability of funds.

I am informed that the Environmental Protection Agency is considering three applications for grants which contemplate the use of the Bureau of Mines Incinerator Residue Recovery system. I intend to follow these applications closely, and if approved, the subsequent operation of the proposed plants. The initial purpose of the introduction of S. 2556 was to assure that a full and fair test of the process on a large-scale was accomplished. If that purpose is carried out under other authority, my purpose will be achieved.

Regardless of whether the Committee moves ahead and acts upon S. 2556, attention has been directed to the Bureau of Mines process, and hopefully pioneering work will be brought to numerous successful applications. If that does not occur, the Committee will be in a position to act swiftly on this measure, and, if passed by both Houses, provide an opportunity for a full scale demonstration of the process.

Mr. Chairman, I ask unanimous consent that an article entitled "A Search for 'Gold' in Our Mountains of Trash", appearing in the Denver Post on May 7, 1972, written by me, be printed in the Record at this point.

Also, a paper entitled, "Separation of Glass from Municipal Refuse—A Review", by Robert J. Ryder and John H. Abrahams, Jr., presented at the Solid Waste Resources Conference sponsored by the Battelle Memorial Institute, Columbus, Ohio, May 13, 1971, be printed in the Record.

A Search for "Gold" in Our Mountains of Trash

(By Senator Gordon Allott)

When the garbage truck stops in front of your house some day soon and the men dump your week's collection into it, you will be adding your bit to the 200 million tons of urban refuse collected in the United States each year. Estimates are that our current mode of life generates more than five pounds of municipal refuse daily for every man, woman and child in America; enough to cover an area half the size of the state of Connecticut with a layer of refuse a foot thick in a year.

The total U.S. bill for collecting and disposing of this mountain range of refuse is $6,000,000,000 annually. Most of it is dumped, buried in land-fills or burned by incineration. About 30 million tons are burned annually in more than 300 municipal incinerators, thus reducing the bulk but still leaving a massive disposal problem. Much of the residue left by burning is then buried in land-fill operations. Sites for sanitary land-fills for both raw and incinerated refuse are becoming harder to find, and there is some evidence that such land-fills may pollute ground water.

Much of this huge volume of refuse is metal—12 million tons of iron and steel, and more than a million tons of aluminum, zinc, lead, tin and copper. Fifteen mil-

lion tons are glass; Americans on the average discard one glass bottle per person every two days. The national total is a staggering 36 *billion* bottles annually.

While we are throwing away these millions of tons of metal each year, we are just as rapidly depleting mineral deposits by ever-increasing mining activity to feed our economy. In 1950, domestic primary demand for all minerals was $14 billion. In 1970, it has risen to $42 billion. In 1970, U.S. primary production of mineral commodities fell more than $8 billion short of meeting demand. Projections indicate that in 1985 it will fall $31 billion short, and in the year 2000 it will be $64 billion short.

Next Thursday, on May 12, the Minerals, Materials and Fuels Subcommittee of the Senate Committee on Interior and Insular Affairs will open hearings on a bill designed to alleviate both of these major problems—the disposal of municipal refuse and the conservation of our scarce mineral resources.

The bill is S. 2556, to establish a municipal mine demonstration plant. I introduced it last fall after reading reports of a remarkable pilot plant a few miles outside Washington which shows great promise of accomplishing three desirable goals:

The recycling of metals and glass from urban wastes.

The reduction of the volume of urban refuse to be disposed of.

The operation of municipal incinerators at a profit rather than at a cost to the taxpayers; or at least at a substantially reduced cost.

The U.S. Bureau of Mines has been active in research on the recycling of solid wastes for several years. One of those research projects began in 1969 in an abandoned warehouse at Edmonston, Maryland. There the Bureau's College Park Metallurgy Research Center—using only existing equipment and techniques from the mining industry—set up a pilot plant for reclaiming and recycling metals and glass contained in the residue from municipal incinerators. By channeling this residue through various size screens, shredders, grinders, magnetic and gravity separators, the plant sorted different kinds of metals and glass from the ashes left by incinerators in various cities around the country.

At College Park and in other Bureau of Mines installations researchers refined and upgraded the reclaimed metals and glass recovered from the residue into marketable products. Iron was smelted directly into pig iron. Nonferrous metals were separated into high purity zinc and a high quality aluminum alloy for reuse in casting new products. At the Bureau's Tuscaloosa, Ala., Metallurgy Research Laboratory colored glass was made into attractive bricks and mineral wools. Techniques have also been developed for making roofing materials, insulation and "glass-phalt" for paving roads from colored glass. Clear glass was recycled into new bottles.

The Edmonston scientists found they could reclaim three-fourths of the incinerator residue, thus reducing considerably the bulk of refuse ashes to be buried or disposed of in other ways. They found that the bricks made from reclaimed glass were every bit as sturdy as existing bricks. And best of all they found that, based upon projections from that small pilot plant, the operating costs of a larger, commercial sized incinerator-recovery system would be considerably less than the value of the recovered minerals. Costs are estimated at $1.80 to $4.06 per ton of residue, depending upon capacity of the incinerator. Current average value of the recycled minerals is $15.76 per ton of residue, which means a net profit of from $11.70 to $13.96 per ton.

All of this, of course, is based on a pilot plant which handles ½ ton of residue an hour, or 12 tons a day in continuous operation. To be of any value in handling the volume of refuse produced by our cities, a much larger plant, with a capacity of at least 1,000 tons of refuse (which would produce 250 tons of residue) a day, will be needed.

Providing for such a plant is the purpose of my municipal mine demonstration plant bill. I would like to see a major plant built and used in the day-to-day operation of some municipal refuse system. Only then can we determine whether the techniques worked out in the pilot plant can be transferred to a large-scale operation, and whether the economics of the large-scale recycling operation are indeed as favorable as the estimates indicate.

My bill would authorize the Secretary of the Interior to enter into a contract with some state, county or city to build a large demonstration plant next to an existing municipal incinerator. The incinerator would have to have a minimum capacity of 1,000 tons of refuse a day. The federal government would advance the funds for the planning and construction of the plant, and would be repaid

from the profits realized through sale of the recycled minerals. Once the initial cost was repaid, title to the plant would be vested in the state or political subdivision which built it. The bill provides $2,000,000 for the planning and construction advance, and $1,000,000 for operational demonstration, research and publication to encourage other municipalities to build similar plants, assuming the demonstration plant is successful.

I am quite optimistic about the chances of my bill in the Senate. Sen. Frank Moss of Utah, Chairman of the Minerals, Materials and Fuels Subcommittee, recently asked to be a co-sponsor, and Senators Len Jordan of Idaho and Clifford Hansen of Wyoming, both of whom are on the Interior Committee, also are co-sponsors.

Two years ago Congress passed and the President signed the Mining and Minerals Policy Act of 1970, which I sponsored, calling for the orderly and economic development of domestic mineral resources and the reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs. As a further step in reaching the goals of that act, this new bill says in part:

"In view of the nation's prodigious consumption of metals and mineral products, every potential source must be examined, evaluated and, if economically and environmentally feasible, developed to meet the needs of industry and national security.

"Great quantities of mineral commodities are wasted each year and, in turn, are causing environmental degredation.

"The objective of wise and efficient use of our natural resources would be materially aided if such wasted mineral commodities were recovered and reused in the industrial productive processes.

"The residue of municipal and other large incinerators represents an extensive mineral resource that is presently not utilized, and it is in the national interest that such resources be recovered and beneficiated for the use of the consumer and industry."

I believe it should become the policy of the federal government to bring the technology of the Edmonston pilot plant to commercial development as quickly as possible. This mining of what can rightly be called "ore above ground" from our municipal wastes has too many benefits not to be explored fully. Once the demonstration plant shows the way, similar plants at cities throughout the nation could reduce the unsightly heaps of refuse which mar our landscape. They could conserve our precious minerals, and they could offer some measure of financial relief to our cities which cannot find the resources to fund those services needed by their citizens.

It is not the intention of my bill to create another big government grant program. If the economics prove to be close to the preliminary figures, municipal administrators all over the country should be encouraged to build such plants with local financing.

I have been particularly intrigued by the fact that no new equipment had to be developed and no new techniques invented for this reclamation project. The separators, grinders and other devices are, figuratively speaking, on the mining industry's shelf now.

I am convinced that the technology which has spawned our environmental problems contains the best answers for solving those problems. What technology has created, technology can, and should, correct. We must learn to use the tools of our technological society to restore to the land, the air, and the water those qualities of clarity and freshness which our advancing civilization have imperiled.

SEPARATION OF GLASS FROM MUNICIPAL REFUSE—A REVIEW

by
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ABSTRACT

The glass container industry approaches the solid waste problem with the conviction that the only viable, long-range solution is the salvage and recycling of most components of refuse.

Research conducted by glass container manufacturers and their trade association, the Glass Container Manufacturers Institute, Inc., indicates that there are more potential uses for salvaged container glass than there is glass available from the solid waste stream now or in the foreseeable future.

Three broad avenues of research are being followed by the industry. It's aims are:

1. *To develop sound commercial uses for large volumes of salvaged glass containers, such as in the manufacture of new bottles and various secondary products.*
2. *To develop systems and techniques for automatically separating the components of refuse so that they may be reclaimed and recycled by industry.*
3. *To pinpoint and resolve whatever problems, if any, glass containers may create in current methods of waste collection and disposal.*

A number of solid waste management systems are in various stages of development by private industry. One such development, which will soon be given a full-scale demonstration project in Franklin, Ohio, is a unique wet system capable of crushing and separating paper pulp, metals and glass from other refuse materials. A glass subsystem, designed under GCMI sponsorship, will be installed to further clean, refine and color sort the waste glass for recycling in glass manufacturing furnaces.

Continued research in developing effective waste separation systems, the glass container industry believes, is essential. If the components of refuse can someday be economically separated, recycled and marketed by industry, pollution from solid waste will be reduced significantly.

INTRODUCTION

Environmental pollution—and its control—has been a concern of the glass container industry for many years. As long ago as 1953, before the problems of litter and solid waste generally were recognized as threats to the quality of life in our environment, the Glass Container Manufacturers Institute and its member companies were instrumental in the founding of Keep America Beautiful, Inc., the national litter prevention organization. Since that time, the glass container industry has continued to furnish significant financial and service support to KAB for its various education and litter law enforcement programs. Four years ago GCMI broadened its environment-oriented activities by establishing an Environmental Pollution Control Program in order to seek solutions to problems related to solid waste management and air and water pollution. We believe we were one of the first industries in America to organize programs of solid waste management and litter prevention on an industry-wide basis.

This presentation, however, will deal only with the role of glass containers in solid waste and the pertinent programs and research currently being sponsored by the glass container industry. Recent studies show that glass constitutes an average of about six and one-half per cent by weight of municipal solid waste. Of this, about five per cent comes from container glass. In fact, according to a study by the Midwest Research Institute, all packaging accounts for only about 13 per cent of total municipal (residential and commercial) and industrial waste. Thus, glass is a relatively minor factor in solid waste.

It cannot, however, be ignored. Under our present mode and standard of living we find that consumer requirements have created a substantial market for convenience packaging of all types, including non-returnable glass containers for soft drinks and malt beverages. Public demand for one-way beverage containers continues, yet half of the glass containers found in waste disposal systems today are not soft drink or beer bottles. They are baby food jars, peanut butter jars, jam and jelly glasses, ketchup and salad dressing bottles, cosmetic and toiletry containers and the like. These glass packages are now and have always been one-way, no-return convenience items.

It seems apparent, therefore, that convenience packaging has a very real place in our society. Although there is a tendency to over-emphasize the role played by glass containers in solid waste, the glass container industry is working to reduce or eliminate such problems as may exist. It is important to understand that ultimately a discarded glass container can meet only one of three possible fates:

1. It can be recycled and made into a new package.
2. It can be used as part of the raw materials needed to manufacture secondary products.
3. It can be buried in a sanitary landfill, or disposed of by some other acceptable means.

These alternatives have been stated in their obvious order of preference. In terms of reclamation and resource conservation, recycling is certainly the most desirable method. However, in an area where there is no glass container manufacturing facility available to accept waste glass, the second

choice must be considered. Finally, where the use of waste glass as cullet or as a component in secondary products is not feasible, the third method of disposal becomes the only practical option.

The thrust of GCMI's efforts, therefore, has been in these same three areas:

1. The reclamation and recycling of used bottles and jars.
2. The development of secondary products made from waste container glass.
3. The improvement and modernization of collection and disposal systems.

SEPARATION AND RECYCLING

Recent studies have shown that there are potential uses for every bit of waste container glass available in the country now or in the foreseeable future. As a first step in the direction of total salvage and reuse of waste container glass, the nation's glass container manufacturers are conducting an industry-wide reclamation and recycling program.

Today GCMI member companies are operating a network of nearly 100 bottle reclamation centers in some 25 states. Since the program was inaugurated on an industry-wide basis on June 30, 1970, many tons of glass containers have been salvaged from solid waste and litter. These salvaged bottles, now being reclaimed at a rate of close to one-half billion a year, are being recycled back into the bottle-making process.

Reports by member companies indicated that crushed waste glass, called cullet, can provide 30 per cent or more of the industry's raw material requirements. Our bottle reclamation program is able to supply only a small portion of this amount. Therefore, in order to obtain salvaged glass in greater quantities, GCMI is cooperating with various research organizations and federal, state and local government agencies to develop efficient, low-cost, highly automated systems for separating the components of raw refuse.

One example is at Stanford Research Institute, where GCMI and the U. S. Environmental Protection Agency sponsored investigation of a process known as the Zig-Zag Air Classification System which utilizes forced air currents to separate refuse materials into its components. To date a major separation of paper and plastics from heavier matter has been achieved. Samples containing between 75 per cent and 90 per cent glass have been obtained readily from the heavier fractions. Further separation, however, becomes more difficult because of the similarity of densities of materials in the heavier fractions. More work is needed to test the efficiency of separating waste glass from metals, but the outlook for this research appears promising.

The industry is working also with various organizations to further refine glass from these preliminary processes for recycling in glass furnaces. To this end GCMI is supporting studies at the Sortex Company at Lowell, Michigan, to optimize the means of optically sorting the glass that has been reclaimed from solid waste into its various colors. On a pilot basis this research is producing color-sorted glass of a quality that can be recycled by our industry. When perfected, it will enable glass container manufacturers to consume large tonnages of salvaged glass.

Further, we have been following and working closely with the U. S. Bureau of Mines on its development of a process utilizing standard ore dressing methods to separate usable materials from incinerator residue and high-intensity magnetic forces to sort glass by color. The Bureau estimates that after the salvage of metals the separation of clear or flint glass costs only an additional 77 cents a ton, using figures for its 250 tons-a-day plant. From a practical standpoint, the potential benefits are enormous. Sorted by color and refined, glass from incinerator residue could be used as cullet to make new bottles or used in secondary products.

Also, a number of solid waste management systems are presently in various stages of development by private industry. Some, in fact, need only the opportunity of a full-scale demonstration in a typical community to prove their worth. One such development, which will be discussed in more detail later in this presentation, is a unique wet system capable of crushing and separating paper pulp, metals and glass from other materials at a reported cost of approximately $3.60 per ton of raw refuse alfter allowing for pulp and ferrous metals salvage. This includes operating costs and amortization in a plant designed to handle 500 tons of waste a day. This system is being constructed at Franklin, Ohio, by the Black Clawson Company with the assistance of a demonstration grant from the Solid Waste Management Office of the U. S. Environmental Protection Agency.

SECONDARY MATERIALS

We define secondary materials as those products other than new glass containers that are made from waste glass. GCMI's research on secondary materials has been directed largely toward determining those products which can incorporate waste container glass which is not sufficiently refined to be used in glass manufacturing furnaces. Generally speaking, these secondary products are in the nature of construction materials where the glass must compete with relatively cheap raw materials.

For example, GCMI and the Environmental Protection Agency for several years have supported studies at the University of Missouri at Rolla which show that glass fragments may be substituted for stone aggregate in glasphalt, one of the better known potential secondary products. But the cost of stone aggregate averages around $2 to $4 a ton. In this case it would not be practical from an economic standpoint to pay processing costs in excess of $5 or $6 a ton for the waste glass alone. However, the cost for processing the refuse mix must be distributed proportionally among all of the salvageable components. This approach must be considered for both the Black Clawson system at Franklin, Ohio, as well as for the U. S. Bureau of Mines incinerator residue reclamation system at Edmonston, Maryland.

Initial calculations indicate that glasphalt alone could use up all the waste container glass available in municipal waste systems now and in the foreseeable future. Estimates for waste container glass in refuse today range between 10 and

15 million tons annually, whereas the amount of stone aggregate used in asphalt approaches a third of a billion tons annually. If waste glass were to be substituted for even three or four per cent of the aggregate, all the glass still would be utilized.

Furthermore, GCMI is funding a study at the University of Missouri at Rolla which will evaluate the amount of foreign material which could be tolerated in glasphalt. If a certain amount of metals and organic materials could be tolerated, then less processing of municipal wastes from proposed mechanical separation systems would be needed and the costs reduced.

Another well known secondary product utilizing waste glass is the brick made from glass-enriched incinerator residue. In the U. S. Bureau of Mines process of removing metals for recovery, a mixture containing some 98 per cent glass is left over. This product can be used directly for making bricks using various binders, such as 10 to 30 per cent of regular brick clay. In general, regular brick making equipment can be used.

In addition to these products, GCMI and its member companies have been conducting studies of some 10 other secondary products which are made from waste container glass.

In one process bricks using waste container glass can be made by using high pressure and cement, and certain chemicals such as those developed by the T-A Materials Company. These bricks can be made to such close tolerance that a paste material can be used instead of standard mortar. With this system various shapes of bricks and blocks can be designed.

Blocks and bricks—even large panels—can be made by a variety of other processes. Studies with GCMI support are being conducted by the Colorado School of Mines Research Institute to use waste container glass as the binding medium for panels 4 feet by 16 feet and up to 4 inches thick. The composition is 6 per cent clay, 13 per cent to 94 per cent glass and 0 per cent to 81 per cent rubble, yielding a bulk density of 130 pounds to 140 pounds per cubic foot depending upon the proportions used. The crushing strength was found to be as high as 12,000 pounds a square inch. Panels containing the higher glass ratio can be polished for decorative effect.

Stanford University is conducting studies using glass and silica with cement and other materials to make an expanded or porous material for insulated wall panels.

Furthermore, glass wool insulation can be manufactured using up to 50 per cent waste glass. This is being done by the U. S. Bureau of Mines using glass recovered from incinerated residue and by at least one commercial manufacturer. The Bureau is also making such other products as glass beads and lightweight aggregate from glass rich incinerated wastes.

In the case of the bricks, blocks, and wall panels, each use could easily absorb the waste container glass in a municipality. Preliminary studies show that many of these products using waste glass could compete with standard construction materials if separation systems were utilized and markets developed.

In California, standard 5/8-inch terrazzo flooring has been developed which utilizes reclaimed glass in place of marble chips. In addition to the regular flooring thickness, a second type, also using waste glass but featuring a new matrix, has been created by the American Cement Technical Center. By incorporating small amounts of polymer substance into the product mix, the company has been able to produce a terrazzo finished to a 1/4-inch thickness with two or three times the flexible strength of normal terrazzo. This new product provides a significant weight saving which can be a major factor in high-rise buildings.

WASTE DISPOSAL METHODS

As we have already indicated, glass containers contribute only a small portion of the solid waste mix. However, if glass is properly ground for disposal in sanitary landfills it returns to the soil in almost its original form and the volume is reduced substantially.

The Institute has sponsored independent studies to determine the degree to which glass containers constitute a solid waste problem. These studies have indicated that waste container glass, when properly handled, is not a problem in present municipal disposal systems.

In solid waste landfills, for example, Drexel University determined that glass does not contribute to any physical problems or chemical pollution. When crushed or ground, glass mixed with the soil becomes a permanent and firm fill which will not settle or erode. In addition, there is virtually no leaching from the glass to cause pollution of ground and stream waters.

Similarly, and despite widespread views to the contrary, glass has not been found to be a significant problem in incineration. Glass containers generally break into fragments due to the heat blast in incinerators. Many of these fragments help aerate from the batch and thus enhance combustion, while other fragments fall through the grates.

According to data collected in a recently completed national opinion survey of municipal, county and solid waste management officials, glass containers were found to be among the least difficult of all packaging materials to handle in refuse collection operations. This study was conducted by the Resources Management Corporation of Bethesda, Maryland, in order to determine directly from officials responsible for solid waste collection their views on the role of packaging materials, particularly glass containers.

Among other things, the study found that almost 70 per cent of the officials believe that no packaging material is damaging to collection equipment. Only two per cent of the respondents felt that glass containers would harm such equipment and only 8.1 per cent considered them difficult to handle. Further, the waste management officials indicated that glass containers are the least troublesome of all packaging materials in landfills and incinerator operations, falling behind steel, plastic and corrugated containers.

However, in general the refuse systems in most municipalities are inadequate and antiquated. Only recently have

municipalities begun to look beyond the garbage man and truck concept of refuse collection. The labor intensive collection systems, in fact, account for 75 to 80 per cent of refuse costs. It is hoped that Federal funds may be provided under the Resources Recovery Act of 1970 to finance projects which will upgrade significantly collection and disposal systems.

LONG-RANGE SOLUTION

Consumer demand has established a market for convenience packaging, and part of the convenience of using such packages is the fact that they can be discarded. The refuse mix must be separated, but we cannot necessarily expect the nation's housewives to do this job.

The nation's glass container manufacturers are convinced that the long-range solution to the presence of glass in solid waste can be found in the separation systems and markets for waste glass which are currently being developed. These systems are designed to separate the various salvageable components of refuse, and glass is but one of these. The enriched, mixed colored glass is a by-product left after other materials are separated, and thus it starts with a zero value, or even a negative value since disposal in a landfill could cost several dollars a ton.

As we have seen, two potential markets are developing for this glass mixture. One is the use of waste glass as cullet in the bottle-making process; the other is its use in various secondary products. By using materials handling methods, glass fragments 1/4 to 3/4 inches across can be freed of contaminants and color sorted for remelting and reforming into containers. Less refined or smaller sized fragments are usable in secondary products also. As indicated earlier, the U. S. Bureau of Mines is developing a system using commercial equipment which is capable of separating sand-sized particles by color.

Today there are perhaps three major approaches to separation. These are wet separation, dry separation, and separation after incineration or pyrolysis. The glass container industry is working closely in the development of several of these systems in order to evaluate the quality of waste container glass produced and the potential markets. Systems using one or more of these basic systems are nearing the stage of practical demonstration.

One of the best known systems is the Hydrasposal method developed by the Black Clawson Company of Middletown, Ohio. A prototype of this wet separation system is being constructed at Franklin, Ohio. When fully installed, this plant will be one of the most complete systems in the country for processing the waste products of our society. The Hydrasposal and Fiberclaim systems, manufactured by Black Clawson, are designed to handle nearly all normal municipal residue except bulky items. Coordinated with this is a modern sewage disposal plant to be built soon by the Miami (Ohio) Conservancy District which will serve Franklin and the surrounding area as well and will process contaminated waste water from the solid waste plant.

The Black Clawson demonstration plant is being designed to handle 50 tons of refuse in an 8-hour day, with a salvage potential over 50 per cent of the total tonnage (see Flow Diagram). The process will first crush the refuse into a liquid slurry small enough to pass a 3/4 or 1 inch diameter opening. Heavy materials settle out, and ferrous metals are removed magnetically. Inorganic materials are then removed in a liquid cyclone, which leaves a residue of heavy materials consisting of 80 per cent glass and nonferrous metals. The light organic portion is reduced into discreet fibers with contaminants screened out.

The glass container industry is interested in the heavy portion containing the 80 per cent glass and has designed a system to refine the glass fraction into a material usable in glass manufacturing furnaces. As such, the glass must be clean, uncontaminated, free of metals, and sorted by color.

The glass subsystem has been designed by GCMI and by the Sortex Company to receive this glass-rich mixture from the Hydrasposal and remove all contaminants before or during color sorting. A prototype of this subsystem is planned for installation at Franklin, Ohio, with the funds to be provided by the Federal Environmental Protection Agency and GCMI. Several research methods for removing contaminants will be used, including washing, screening, and air and optical separation. The initial steps will be to:

1. Receive the mixture and remove strong magnetics.
2. Size to separate the glass into the fractions larger than 1/4 inch and smaller than 3/4 inch.
3. Dry before further processing.

The glass fragments larger than 1/4 inch will be processed further in preparation for color sorting with the Sortex machine, and the smaller samples either removed from the system for use in secondary products, or passed through an air classifier in preparation for an experimental high tension electrostatic separator to remove the clear glass.

In preparation for the Sortex separator, the large fragments (1/4 inch to 3/4 inch) will be subjected to a cyclone air classifier and a zig-zag classifier. These two separation systems will be in service for this experimental subsystem, but the most efficient of the two systems probably would be used in a second generation subsystem. The Sortex optical sorter scans each fragment as it passes through a filtered beam of light and sorts the clear glass from colored glass and contaminants. A second pass of the rejects would then sort the greens from the remaining mixture, until all economically salvageable glass fragments are removed.

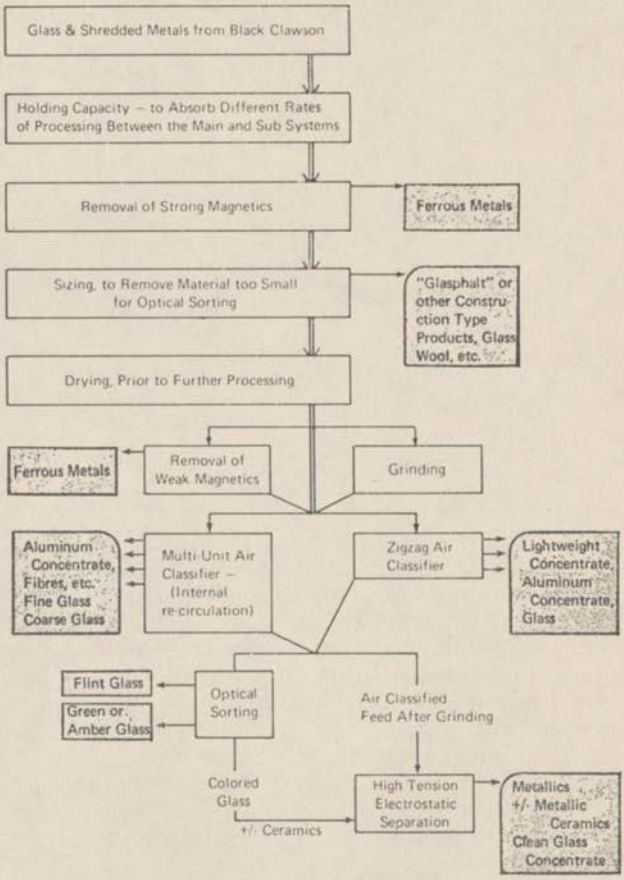
The glass subsystem is an experimental unit designed to determine the effectiveness of various separation systems for glass. It is anticipated that the subsystem, with proper modifications, could be adapted to one or more of the several mechanical separation systems being developed.

CONCLUSION

These, then, are some of the steps that have been taken by the glass container industry to help alleviate its contribution to the nation's growing solid waste problem. The ultimate goal toward which we are working is the eventual separation and salvage of usable waste components and their return to industry for recycling.

Hopefully, future generations will see a nation-wide network of refuse processing stations, perhaps designed along the order of the Franklin, Ohio, pilot project, where municipalities, or even utilities, will separate wastes mechanically and automatically and subsequently sell the recyclable materials to manufacturers or refiners. Such systems, we believe, will result in the much needed conservation of our natural resources and reduce pollution from solid waste.

Essential Details and Flow Diagram of the Proposed Subsystem for the Municipal Separation Plant at Franklin, Ohio.



ENVIRONMENTAL PROTECTION AGENCY,
SOLID WASTE MANAGEMENT OFFICE,
Rockville, Md., July 25, 1972.

CHARLES COOK,
Minority Counsel, Senate Interior and Insular Affairs Committee, New Senate Office Building, Washington, D.C.

DEAR MR. COOK: In response to your verbal request today, I am attaching for your information a list of the communities that have submitted formal applications for Section 208 demonstration grants. The communities marked have requested support for incinerator residue recovery systems incorporating the Bureau of Mines technology. The funding levels associated with these requests are also noted.

All of these applications are now being evaluated, and we expect that the announcement of awards on three applications will be made by the end of August.

Sincerely yours,

SAMUEL HALE, Jr.,
Deputy Assistant Administrator for Solid Waste Management Programs.

Enclosure.

SEC. 208 FORMAL APPLICATIONS

City	EPA funds requested	Process
Dover, Del		Humus.
Memphis, Tenn		Wet Shredding.
Norwalk, Conn		Do.
Baltimore, Md		Pyrolysis.
Charleston, W. Va		Do.
Ellensburg, Wash		Do.
Mt. Vernon, N.Y		Do.
San Diego, Calif		Do.
Salt Lake City, Utah		Dry Separation.
Chicago, Ill	$2,456,815	Bureau of Mines (Incinerator Residue Recovery).
District of Columbia	4,704,746	Do.
Lowell, Mass	2,385,000	Do.
Fort Wayne, Ind		Solid waste as a fuel (cubettes).
Erie, Pa		Solid waste as a fuel.
Malden, Mass		High temperature incineration.
Cayce, S.C		Source Separation.
Tulsa, Okla		Modified open pit incinerator.

Senator Moss. We are pleased to have this morning as our witness, Dr. Elbert F. Osborn, Director of the Bureau of Mines, who would be charged with the administration of this act if this bill became law and we would like to hear from Dr. Osborn to get a reading on the situation as it exists now and to determine what, if anything, we may be able to do further in this session of the Congress.

Dr. Osborn, will you come forward, please. We are always glad to have you before our committee.

Dr. OSBORN. Thank you, very much, Senator Moss.

May I introduce to you my colleague, Carl Rampacek, he is Assistant Director for Metallurgy who is in charge of this program.

Senator Moss. Mr. Rampacek, we are very pleased to have you. Will you sit at the table, please.

STATEMENT OF DR. E. F. OSBORN, DIRECTOR, BUREAU OF MINES

Dr. OSBORN. I am pleased to have the opportunity to appear before this committee to present the views of the Department of the Interior's Bureau of Mines on S. 2556 which would authorize the Secretary of the Interior, in partnership with a State or municipality, to build, on donated land, a commercial size demonstration plant to separate and recover the metal and mineral values contained in municipal incinera-

tor residues. Federal expenditures for the project are to be repaid with interest by the non-Federal partner within 30 years from the date the Secretary determines the facility can be operated profitably by the State or subdivision.

S. 2556 further proposes that the Department expand its current solid waste recycling process for treating municipal incinerator residues to a demonstration size scale based on the present model developed by the Bureau of Mines. The bill would authorize to be appropriated to the Department of the Interior $2 million for design and construction of the plant and $1 million for operation and demonstration. We fully support the goals of this legislation and congratulate Senator Allott on his foresight for drafting such a progressive piece of legislation which is aimed at solving one of the most critical solid waste problems confronting the Nation today.

He also wisely inserted a repayment stipulation in the bill, which would enable the Federal Government to recapture the entire initial capital investment of the demonstration plant.

However, in light of the action currently underway by the Environmental Protection Agency requesting proposals from municipalities to construct and operate resource recovery plants for processing urban refuse, we feel that passage of S. 2556 may be unnecessary. EPA, in a letter to the OMB, reports that of the eight applications selected in the first-round cut, three of the eight are based on Bureau of Mines technologies. Although there is no absolute assurance that one of the successful grantees will involve the Bureau's technology, EPA states that chances are good that at least one of the Bureau of Mines systems will, in fact, be funded.

In such an instance, the Department will work closely with the municipality in an advisory capacity in order to determine optimum operating conditions for the process necessary to encourage States and their political subdivisions, as well as private industry to utilize the process.

For many years now we have enjoyed growing affluence in this country and, as we have become richer, we have become more wasteful. We see the byproducts of our high standard of living along every roadside, in unsightly junkyards, and in ugly and unsanitary open dumps scattered across the Nation. A widening river of waste—roughly 400 million tons of it each year—flows from our homes, our businesses, our cities, and our industrial plants.

Annually, we now discard some 600 million cans, 36 billion bottles, 40 million tons of paper and paper products, 5 million tons of plastics and countless millions of tons of refrigerators, stoves, TV sets, and similar items. It costs the Nation $6 billion each year to collect and dispose of our urban solid wastes alone.

The fact that this committee is hearing testimony on S. 2556 demonstrates that it does not consider urban waste a useless agreement. We, in the Bureau of Mines, are in complete agreement. We are faced daily with the mounting problems of resource depletion and conservation, of assessing the staggering demand for minerals and metals that we know will exist over the next few decades and, most importantly, of determining how we can meet this demand without irreversible harm to our environment, our economy, and our well-being.

Certainly, it cannot be met if we continue to manage our solid wastes in ways that encourage the discard and loss of enormous quantities of nonrenewable metal, mineral, and energy sources. Last year over 12 million tons of iron and steel, 15 million tons of glass, and over a million tons of aluminum, tin, lead, zinc, and copper were buried in our city dumps. We would have the energy equivalent of 60 million tons of coal if we were to burn the combustible fraction of urban waste and convert it to steam and electricity.

Clearly, it is in the national interest to stem this vital resource loss and, in turn, augment our dwindling metal and mineral supplies. The construction and operation of a demonstration-size plant as proposed by S. 2556 would be an important and meaningful contribution to that end.

Currently, we supply from old scrap, 24 percent of our copper demand, 28 percent of the demand for iron, 38 percent of the lead, and only about 5 percent of our zinc and aluminum requirements. Commercial adaptation of solid waste resource recovery systems will give us the opportunity to increase these percentages significanty.

Fulfillment of the objectives of S. 2556 will not by any means solve all of our urban waste disposal problems, because it is directed only to the recovery of values from incinerated refuse and this constitutes only about 15 percent of our total urban refuse. But, in terms of urgency in our major cities, this fraction can be deceiving. Our cities long ago ran out of suitable, close-in land sites to be used in disposing of their refuse, either by incineration or by other means. In some metropolitan areas, the disposal of refuse is now one of the most serious problems confronting municipal officials. Clearly, our cities need help, if they are not to be buried in their own litter.

We believe that implementation of solid waste recovery systems such as that described in S. 2556 can help to keep that from happening in many of our metropolitan areas.

Faced with runaway waste collection and disposal costs, with ever increasing tonnages of solid wastes and the problem of nowhere to put it, our cities and municipalities are not likely to adopt immediately any economical, demonstrated solution to their dilemma. Construction and operation of a plant as proposed in the subject legislation could quickly elevate several very promising technologies for converting the major metal and mineral values in waste incinerator residues into saleable products. It would also provide a means to demonstrate that recycling the values in urban waste is not only good resource conservation but that it may be a profitable operation as well.

Much of preliminary groundwork for a proposed demonstration has already been laid by the Bureau of Mines. In meeting the responsibilities inherent in the Organic Act of 1910 which established it, the Bureau has been active in reclaiming values from byproducts of mineral, metal and energy processes for more than 60 years and, with the passage of the Solid Waste Disposal Act of 1965, Public Law 89–272, the Bureau was able to expand its research program in separating, recovering and recycling the values contained in a variety of metal, mineral and energy-laden solid wastes. One of the more promising technologies that evolved from this work was the development of the process toward which S. 2556 is directed.

Years ago, the Bureau sensed the emerging national concern over the accumulation of urban solid wastes and recognized that such wastes were, in reality, high-grade ores amenable to conventional ore dressing and metallurgical treatment and technology. Realizing that the potential value in such wastes could satisfy a large part of the rapidly expanding mineral demand, we began in the early 1960's to direct more of our efforts toward developing and demonstrating integrated systems for recovering and recycling them.

The Bureau has now developed and proven at the pilot plant level, a completely engineered process that automatically and continuously separates and recovers the tin cans, iron products, aluminum, copper, lead, zinc, glass and other mineral values from incinerated refuse in much the same way that minerals are separated from their ores.

The method is not only technically feasible, but shows favorable economics. Each ton of residue contains about 600 pounds of ferrous products, 55 pounds of nonferrous metals, and nearly 1,000 pounds of glass having a market value of $15 per ton. Operating costs, including plant amortization over 20 years, for a commercial size plant, are about $2 per ton of residues treated. All of the products can be reprocessed and reused.

Typical of potential products are new glass containers, strucural bricks and insulation wool from waste glass. The iron and nonferrous metals can be made available to foundries, steel mills and secondary metal processors. However, the economic and environmental benefits likely to be derived from the process will likely not be realized unless it is demonstrated on a scale large enough to convince private and municipal bodies of its practicality and potential. This will also open the door to large-scale testing, evaluation and marketing of the recoverable products.

In summary, we believe, that the Bureau has demonstrated its capability in this important field of research and development. In support of this is the fact that several municipalities have submitted applications for demonstration grants to the Environmental Protection Agency which utilize technologies as developed by the Bureau. Moreover, we are hopeful that such systems will be chosen by EPA for fullscale demonstration.

Senator Moss, may I reiterate what I have said just quickly, by referring to these charts?

Senator Moss. Yes.

Dr. Osborn. (Chart with no title) The urban waste alone is about 200 million tons a year, about half of the total waste. This contains about 15 million tons of glass, about 12 million tons of iron and about 1 million tons of nonferrous metals, besides enough energy, if used to, say, produce steam, equivalent to about 60 million tons of coal. That is just about the same amount of coal we export each year.

Senator Moss. Can the energy that is in the waste be used to operate the incinerating process, or do you have to bring in outside energy, gas or oil?

Dr. Osborn. The incinerator process is self-sustaining, and the heat produced can be used to generate steam which can then have other uses. The net heat in 200 million tons of refuse is equivalent to about 60 million tons of coal. There are some operations now where they are not treating the residue, but nonetheless, are making use of the energy.

The process is very simply shown on this next chart (Title: Residue Treatment Process) which we demonstrate in our pilot plant at College Park, Md.—some of you have seen the plant. When a thousand tons of raw refuse, garbage, and so on are burned, we end up with about a quarter of that as residue.

In other words, about three-quarters of the raw refuse is combustible. We end up with about 250 tons of residue. This is the amount that would be generated by a city of 300,000 population. The residue goes through coarse screening, shredding, and magnetic separating steps to recover the iron which amounts to about 76 tons.

The material is further ground and screened to separate nonferrous metals such as aluminum, zinc, lead, and copper which add up to 6.5 tons. Then, the glass fraction, which by now is finely ground, is separated into colored and colorless fractions. The reason for doing that is that the colorless glass fraction can be recycled for making new glass and brings about $14 a ton, whereas the colored glass is worth something like $4 a ton.

The third of these four charts (chart title: Resources from Refuse) again illustrates, but in a different way, the process and how it can fit into a city collection system. Here a thousand tons a day of refuse are being incinerated, producing about 250 tons of residue. The steam produced is worth about $214,000.

The recycling plant then handles 65,000 tons a year of residue. The products recovered are, as you can see, about $296,000 worth of nonferrous materials other than aluminum, about $249,000 worth of aluminum, $198,000 worth of ferrous materials, $213,000 of colorless glass and $64,000 of colored glass. The total salable value of products from a town of 300,000 therefore is about $1 million.

In other words, about a million dollars worth of salable products at a cost of operation, including amortization of the plant, of about $250,000.

And this last chart (chart title: Products in One Ton of Residue) gives another breakdown that might be helpful. It shows that in 1 ton of residue, and this is what we handle each hour in our plant at College Park, we produce an average of 610 pounds of ferrous metal worth $3.05. Aluminum, 32 pounds worth $3.84. Copper, lead, zinc, 24 pounds worth $4.56. Glass, colorless and colored, worth $3.31 and $1, respectively. The gross value of these materials is $15.76. The treatment cost is about $4, leaving about $9.73 per ton as profit.

Senator Moss. Do you expect that this would hold up on the larger scale, that same ratio?

Dr. Osborn. Yes, Senator Moss. We have tested samples, several tons of samples, from incinerators all over the country and they are surprisingly uniform. In other words, people have about the same pattern of living whether they are in Salt Lake City or New York, so we feel quite confident that this is just about the way it will turn out.

You might ask then, why do we need to do this on a larger scale, if we know all about it? One of the principal reasons for the larger demonstration plant is that we need to demonstrate the process on a large enough scale to convince mayors, councilmen, and industry people that the incinerated residue can be treated on a commercial basis. To build plants of this kind officials of our municipalities have to sell bonds

and make promises to their constituents with respect to what they are going to do with the taxpayers' money—if they want to be reelected.

They have to be able to say, look, we have seen this plant, it works, whereas, if they come to College Park, they see something that works also, but it is only a toy compared to the size of plant a city needs.

Senator Moss. Ordinarily, when you go to a larger scale, you get some economies that come in from a larger scale and I wonder whether you have calculated that?

Dr. Osborn. Yes; we have. That is a very good point, Senator. On a small scale it costs about $4 a ton, whereas, on the larger scale that we are referring to, it could be done for as low as $2 a ton.

Senator Moss. Is that treatment cost? Do you put in any amount for labor?

Dr. Osborn. That is the whole cost, the labor, materials and the amortization of the plant. The original capitalization cost of the plant.

I would like to——

Senator Moss. By the way, I would hope that we could have those charts reduced and placed in the record, and if that can be done, we will have them following your explanation.

Dr. Osborn (continuing). I will be very glad to do that. Along this same line, I would like to mention a recent publication summarizing our solid waste research efforts. The title of this publication is "Bureau of Mines Research Programs on Recycling and Disposal of Minerals, Metals and Energy Based Solid Wastes." I would like to make it available to your committee. This report not only describes the process we have been discussing but it also mentions other processes which are so important. For example, the automobile smokeless incinerator work we have done and the conversion of organic wastes to oil.

PRODUCTS IN ONE TON OF RESIDUE

PRODUCT	POUNDS	VALUE $
FERROUS METAL	610	3.05
ALUMINUM	32	3.84
COPPER, LEAD, ZINC	24	4.56
GLASS		
COLORLESS	552	3.31
COLORED	398	1.00
GROSS VALUE		15.76
TREATMENT COST (250 TPD)		4.03
NET VALUE		9 73

200 MILLION TONS

HOUSEHOLD AND COMMERCIAL REFUSE

GENERATED ANNUALLY

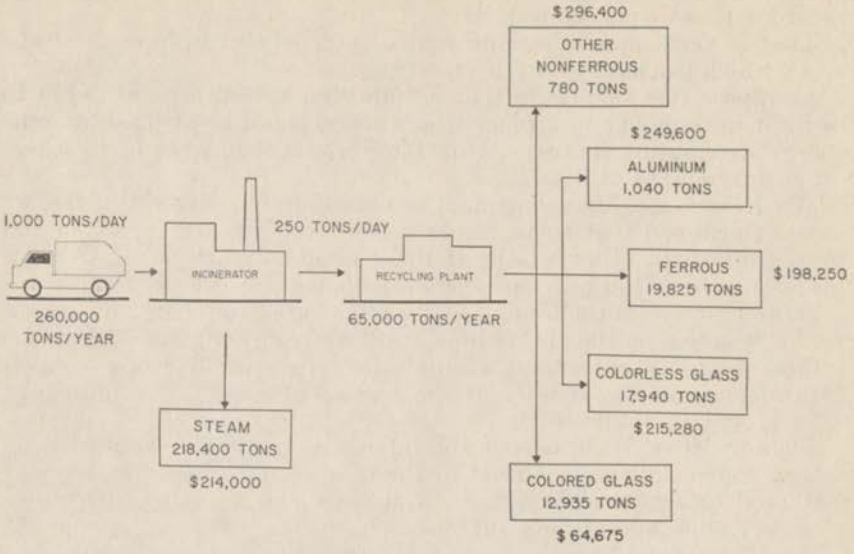
CONTAIN

15 MILLION TONS GLASS

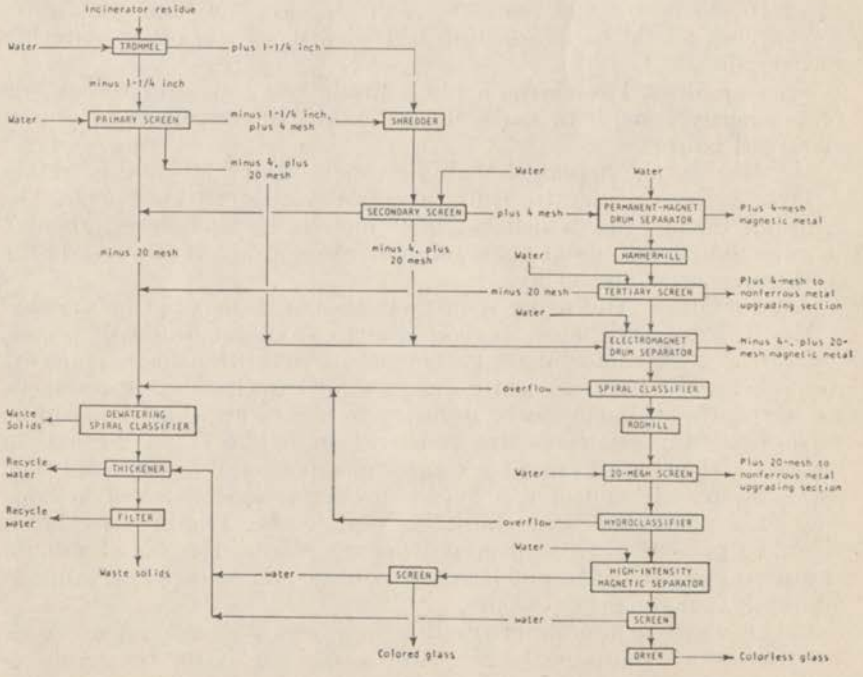
12 MILLION TONS IRON

1 MILLION TONS NONFERROUS METALS

RESOURCES FROM REFUSE



RESIDUE TREATMENT PROCESS



Senator Moss. We are pleased to have that. It will be incorporated by reference and be in our files and attention will be called to it in the record so that we may consult it.

That is very interesting and really very helpful to have the testimony which you have given this morning.

I suppose that one thing that is indicated is that a plant ought to be built in each city in a place where steam could be utilized by some energy demanding industry. How close would it have to be to where the steam could be utilized?

Mr. RAMPACEK. Mr. Chairman, in obtaining our cost estimates, we have determined that there would be a marketing area of about 100 to 150 miles. In other words, if these plants were located within a radius of about 150 miles of the steel plants and the nonferrous industries that accept the kind of materials we are producing, the figures we have shown on the charts hold true. And since a good deal of our refuse is generated in and around the large urban centers which naturally are in the vicinity of these kinds of plants, the figures we have quoted are quite firm.

Senator Moss. Well, one of the interesting products would be the energy that could be produced in the combustion process and would that need to be some place where you have a consumption of energy necessary, some operating plant?

Mr. RAMPACEK. Yes, it would. Of course, the energy could be converted either to steam, which could be used as such, or it could be converted to electricity. In our estimates here, we have assigned a dollar value to the power and the steam, but we have not taken credit for them. That would be in addition to the value of the other materials recovered.

Senator Moss. How large a plant would you have to have to generate energy enough to make it economical to convert it to power, electrical power?

Mr. RAMPACEK. A plant burning a thousand or 1,500 tons of refuse a day. Such an incinerator can economically generate electricity. The Chicago incinerator, which is a new one, and was finished about 6 months ago, treats about 1,600 tons of refuse a day, and converts the heat into energy, electricity.

Senator Moss. And using it in their electrical distribution system?

Mr. RAMPACEK. That is correct. It is an auxiliary source of power.

Dr. OSBORN. Senator Moss, I want to call your attention to some exhibits here. We have worked on ways to utilize the residue products, we have provided samples to industry to make sure that they can be used. For example, these are construction bricks. They have been tested for their weathering resistance for a period of 3 years and they are standing up well. These bricks are being used to construct one wall of a plant now being built in New Jersey. The bricks contain about 70 percent glass recovered from the refuse. Here is aluminum and here you can make out parts of tin cans. These are the valuable materials that you get out of ore.

This is a coarse aluminum fraction, and here is a heavy, nonferrous fraction which contains the zinc and lead. Here is the nonmagnetic glass mixture before we separate it into colored and colorless fractions. This is glass wool.

We sent 10 tons of our glass to a commercial glass container manufacturing plant which made a half-million beer bottles like the one I have here. Of course, they are perfectly acceptable.

Senator Moss. This is a full process of melting it down and recasting it into a bottle?

Mr. OSBORN. Yes. In other words, although people in the trade know that you can use waste glass to do this, it is helpful to demonstrate to the general public which is not aware that waste glass is useful. In other words, it does not deteriorate. You can remelt it and use it again.

Finally, following good metallurgical practice, we have melted down some of the residue products and cast them into aluminum, zinc, brass, and copper ingots. One other point I want to emphasize, and that is that the separation process is very simple. The individual separation processes we use are off the shelf. These are well known in the mining and mineral preparation industry. What the Bureau has done is to select the various screens, magnetic separators and other equipment and put them together into a system. We didn't have to develop new machinery. That was the important thing that was done.

Finally, if you or any of your colleagues would like a little kit to show what is done with waste glass, this is something that was put out by the Glass Container Institute.

Senator Moss. That would be very interesting.

Well, I appreciate very much having your testimony and your explanations here this morning. Mr. Rampacek's as well. Of course, it does offer a great deal of hope rather than just being continually buried in refuse and having it cost us $16 million with no return. This indicates that we can recover enough perhaps to pay for the process of picking it up, but make even a small profit. Beyond that, enough to amortize the building of the plant and the operating of the plant, and of course, the fall-out that is appealing to you gentlemen and to this committee is that by recycling and using over and over again our resources, we take some of the pressure off of our dwindling reserves that bother us greatly.

Mr. OSBORN. Yes, that has been the primary interest of the Bureau over the years—working on the mineral resources problem.

Senator Moss. I do commend you very much for the research done by the Bureau up to this point and the vision you have in expanding it still further. We are concerned about it here and have been glad to have your testimony before us today.

We thank you very much, and this will conclude what we have scheduled for this morning.

(Whereupon, at 4 p.m. on July 26, 1972, the hearing was adjourned, subject to the call of the Chair.)

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