Utilization Of Incinerator Ash As Landfill Cover Material

G. J. REQUARDT and W. M. HARRINGTON, Jr.

ABSTRACT

The collection and disposal of solid wastes is a vital service required by every modern community for the convenience and the protection of the health of its members. The disposal program in any area must be considered from the standpoint of total refuse production even though all phases of the program are not always the responsibility of the same agency.

This paper discusses a way in which the incineration program can aid in the proper operation of the landfill portion of a total refuse disposal program to the mutual benefit of the entire community.

INTRODUCTION

The collection and disposal of solid wastes has been one of the necessary services required by all organized societies since the beginning of time. When large groups of people congregate in confined geographic locations to live and work, the proper operation of this service becomes vital to the health of each of these individuals. To be adequate, a refuse disposal service must be designed to assure the final disposition of all of the solid wastes produced in an area, regardless of the type of refuse or how it is produced. Consequently, a solution to the problems involved in one phase of disposal which benefits another phase of the total disposal program is desirable even when the two phases are not included in a single area of responsibility. The use of incinerator ash residue as land fill cover material offers this desirable benefit.

BACKGROUND

Refuse disposal in the Baltimore metropolitan area, which consists of Baltimore City surrounded on four sides by Baltimore and Anne Arundel Counties, has evolved to the point that large quantities of readily combustible solid wastes collected in Baltimore City are volumetrically reduced in City incinerators prior to final disposal by land filling. Baltimore County operates sanitary land fills for the disposal of garbage and mixed domestic refuse collected by private operators under contract to Baltimore County. Refuse from the portion of Anne Arundel County adjacent to Baltimore City and included in the Baltimore metropolitan area is collected by private operators who are also responsible for the disposal of the refuse collected. In addition to the services provided by the local governments, there are large quantities of industrial and commercial refuse collected and disposed of by privately operated disposal businesses on open dumps and in modified land fills.

As citizens become more cognizant of the health hazards involved with open dumping practices and controlling regulations become increasingly restrictive, larger quantities of solid wastes will either be diverted to existing sanitary land fills or existing open dump

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operators will be required to adjust their operations so as to more nearly comply with good sanitary land fill practices. The economics of refuse disposal generally dictate that land filling be used for the disposal of solid wastes where land is available for this purpose, and it is reasonable to expect that problem wastes will be disposed of by this method for an indefinite period.

In addition to the economic advantage, there are other benefits to be derived from properly conducted land filling operations. In many instances blemishes of nature have been erased by land filling and have been replaced with parks, parking areas, and other light load uses to the benefit of the community. The availability of an economical cover material of a satisfactory nature justifies a continuation of this practice in areas such as marshes, ravines, abandoned quarries, etc. where the expense of clean earth cover material might prohibit their use as disposal sites.

Robb Tyler, Inc., a large private refuse collection and disposal business in the Baltimore metropolitan area, felt the full brunt of the trend to eliminate unregulated land filling areas when the rapid construction of residences in the vicinity of the company's main disposal area created an immediate need to modify many of the accepted disposal practices of the past. Tyler engaged the Consulting Engineering firm of Whitman, Requardt and Associates to study the disposal operation and recommend an operating procedure which would reduce the nuisance created by this operation.

Prior to this time Tyler had used ash residue from a nearby Baltimore City incinerator for roadway stabilization and as foundation material for a primitive refuse burner. The Tyler experience with this material had been satisfactory, and a contract had been negotiated with Baltimore City for all of the residue from an 800-ton-per-day plant. In the fall of 1961 this material, in excess of that needed for roadway stabilization, was incorporated in the general fill. In practice the agreement worked very well in that Baltimore City gained a reasonably close ash disposal site at no cost, beyond hauling, thus saving precious City-owned ash disposal areas, and Tyler gained needed stabilization material.

The Consulting Engineers and Mr. William A. Xanten, Superintendent, Division of Sanitation, Washington, D. C., whose special consulting services were engaged for this project, investigated the Tyler site and operation and made recommendations designed to reduce the nuisance to acceptable limits. The recommendations to Robb Tyler, Inc. were modifications of the "Suggested Land Fill Standards and Methods" by Ralph J. Black, as published in the *Refuse Removal Journal* issue of October 31, 1961, to take into account the special characteristics of the material handled and the site involved. Evaluation of the recommended methods of operation, based on the point system outlined in Mr. Black's article, placed the operation well within the limits of a modified land fill. The availability of incinerator ash residue and a practical knowledge of the characteristics of the material, based on experience, dictated that it be used for cover material.

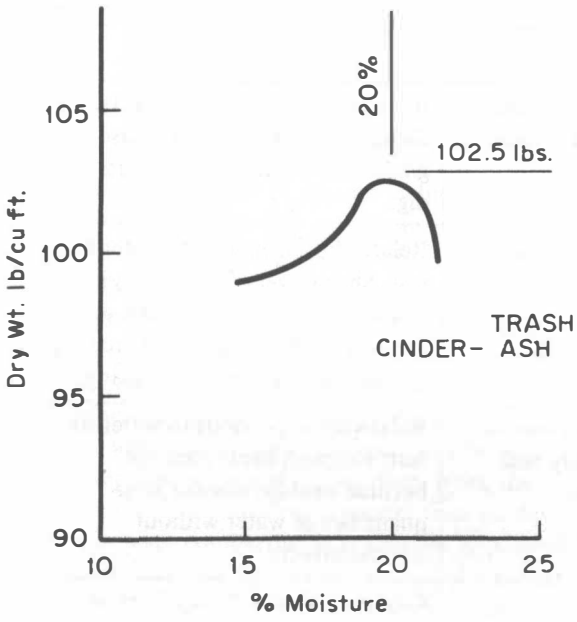
Robb Tyler, Inc. requested that County officials make a special exception to the Baltimore County zoning regulations, which only allowed the operation of a complete sanitary land fill in the County, in order that Tyler could proceed to operate the disposal area as a modified land fill based on WR&A and Xanten recommendations. An open hearing was held before the Zoning Commissioner with the local Improvement Association and many householders offering evidence of past bad practices in an attempt to have the plea denied. The request for the exception was denied by the Zoning Commissioner because of the "lack of controlling regulations for a modified land fill."

Since the Zoning hearing, a bill has been brought before the Baltimore County Council to add a section to the Baltimore County Code which establishes regulations governing the collection, storage, and disposal of refuse within Baltimore County. These regulations outline the requirements for operating both land fills and incinerators in a safe and sanitary manner. The proposed regulations, if adopted, will require that all refuse disposal operators in Baltimore County, Maryland, comply with sanitary disposal practices.

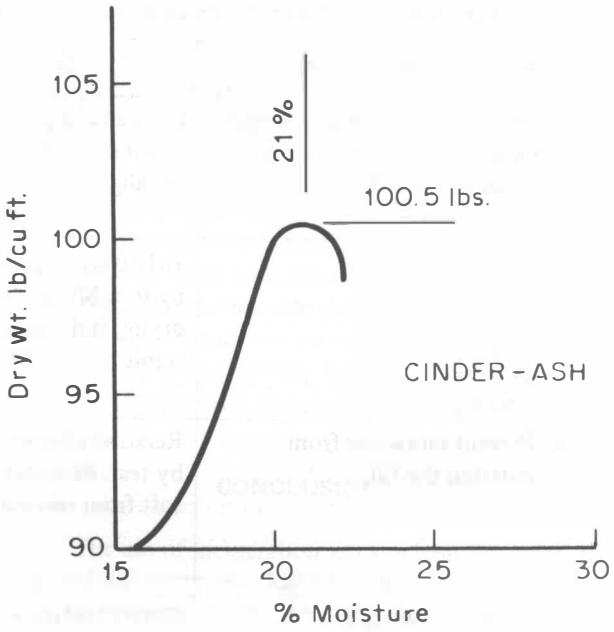
TESTS PERFORMED

At the zoning hearing, representatives of the improvement association had objected to use of incinerator ash in any form on the fill. While engineers experienced in incineration are familiar with the advantages of the residue, these advantages are peculiarly unknown to the layman, as well as to many soils engineers. Pending the results of an appeal of the Zoning Commissioner's ruling by the Tyler attorneys, it was decided to have scientific tests run on incinerator ash to prove its value to those unfamiliar with its qualities.

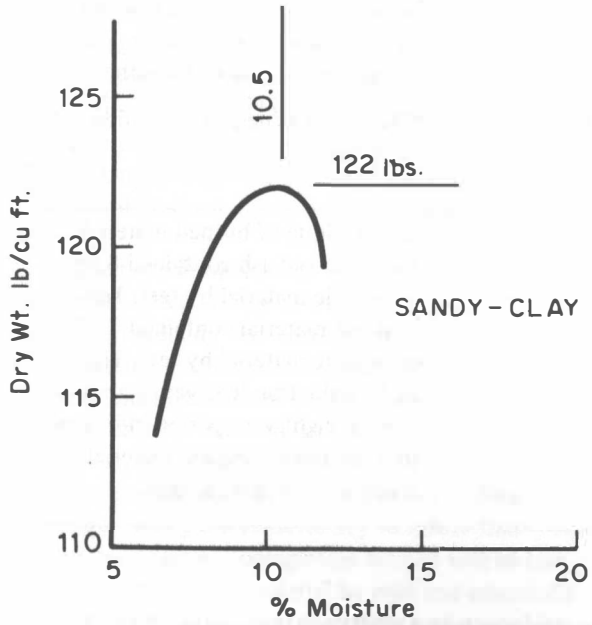
Probably the most controversial characteristic of residue from properly incinerated refuse is the presence of tin cans. Incinerator operators know, from practical experience, that the incineration process removes the protective coating from these cans leaving



WHITMAN, REQUARDT & ASSOCIATES
REEDBIRD AVENUE – DUMP
ABOUT 100 YDS. EAST OF REEDBIRD AVENUE
ABOUT 150 YDS. SOUTH OF SEWAGE DISPOSAL PLANT
STANDARD AASHO COMPACTION – METHOD T-99,
METHOD D, W.O. 5112-1



WHITMAN, REQUARDT AND ASSOCIATES
TYLER SAMPLE
STANDARD AASHO COMPACTION – METHOD T-99,
METHOD D.
ROBB TYLER, INC.
OFFICE SITE – 50' E. of WILCO BURNER
W.O. 5112-1



WHITMAN, REQUARDT & ASSOCIATES
TYLER SANITARY LAND FILL
BATAVIA
STANDARD AASHO COMPACTION – METHOD T-99,
METHOD D.
COUNTY LAND FILL – BATAVIA & N.W. CORNER –
OFF RT. 40,
W.O. 5112-1

a thin steel shell that oxidizes and disintegrates readily in the ash disposal area. This process of oxidation is frequently completed in a six- to eight-month period. However, it was considered necessary to devise a reasonable testing program that would show the merits of the material as cover for a sanitary land fill.

Samples were first obtained of an acceptable sandy clay cover material from a Baltimore County-operated sanitary land fill in order to provide a standard for comparison with the ash. Then, with the realization that new ash residue which still contained unoxidized tin cans would be difficult to test, but realizing that there is little change in properly incinerated ash except oxidation of the cans, a stockpile of two-year-old ash was tested for possible use as cover material. Ten-year-old incinerator ash was also compared to give a basis for determining final deterioration of the ash residue. Testing was conducted by Penniman and Browne, Inc., an independent testing laboratory, with sampling directed by WR&A.

Cover material for sanitary land fills must be compactable to a dense, reasonably impervious blanket which will form a tight seal over the refuse it covers. It must not shrink excessively from changes in moisutre content or crack from slight settlement

COMPARATIVE PROPERTIES OF SANDY CLAY AND INCINERATOR ASH AS COVER MATERIALS

MATERIAL REQUIREMENTS*	SANDY CLAY	INCINERATOR ASH
1. Prevent flies from laying eggs on refuse or rodents from invading the fill.	Inert and impervious to insects. Clean soft soil in which rodents can dig.	Inert and impervious to insects. Sharp hard particles and coarse gradation. Difficult for rodents to dig.
2. Seal in odors.	Relatively impervious to water by test. Shrinks slightly on drying and has low internal stability to resist cracking.	Relatively impervious to water by test. Shrinks very little on drying and has high internal friction and some cementing properties, making it stable against surface cracking.
3. Prevent rainwater from entering the fill.	Relatively impervious to water by test. Becomes muddy and soft from rainwater.	Relatively impervious to water by test. Remains hard, does not become muddy, absorbs large quantities of water without adverse effects.
4. Prevent blowing and scattering of refuse.	Covers surface with soil blanket.	Covers surface with an effective blanket of inert material.
5. Reduce fire hazard.	Will not burn.	Has been burned out previously and will not burn in present state.
6. Help produce a dense, stable fill.	Sandy clay gradation. Compacts to impervious soil blanket, becomes soft and muddy during rainy weather. Cannot be compacted in wet weather.	Gradation equivalent to well graded sand and gravel. Compacts to dense, hard, impervious blanket. Does not become muddy and remains stable and rigid during all weather. Can be compacted during wet weather.
7. Prevent previously laid fly larvae from emerging from fill.	Effective; has slight tendency to shrink.	Effective; has negligible tendency to shrink.
8. Must be relatively free of putrescible material.	Inert soil. Contained 1.5% of organic material by test.	Inert residue of burned material. Two-year-old ash contained 8.8% of organic material by test. Ten-year-old material contained 7.2% of organic material by test. The slight reduction in organic content over an eight-year period indicates that contained organic material is stable and not putrescible.

of the material below. Cover material must also be relatively free from putrescible material or odors and must be fireproof. The following tests were conducted on the sandy-clay standard, incinerator ash from a two-year-old stockpile and incinerator ash from a ten-year-old ash spoil area:

1. Compaction test (moisture, density relations) by the standard ASSHO test designation T99-57, Method D.
2. Sieve analysis for grain size determination.
3. Field moisture content.
4. Permeability of a compacted sample.
5. Special swell, shrinkage, and moisture-absorption tests using modifications of U. S. Corps

of Engineers procedure for analysis for compacted fills.

6. Organic content by loss on ignition.

EVALUATION OF TEST RESULTS

Copies of the test results are included in the appendix of this paper. The results are evaluated and summarized in the accompanying table.

It can be seen from this table that a primary advantage of the ash over acceptable sandy clay cover material is its compactability over a broad range of weather conditions. The incinerator ash tested can be satisfactorily compacted during wet or dry weather; whereas, the sandy clay can only be properly compacted during normal dry weather. When the sandy clay moisture content is greater than the optimum, in place compaction is practically impossible to achieve. The daily operation required of a sanitary land fill adds importance to this primary advantage.

A second advantage of incinerator ash as cover material, as compared to sandy clay, is its greater internal strength after compaction and its freedom from shrinkage upon drying. These characteristics help to prevent cracking of the surface which would be harmful by allowing access for water, insects, or rodents to and from the covered refuse and would allow the escape of odorous gases.

A third major advantage is that afforded by surface rigidity and the lack of muddyness in the area during rainy weather. This advantage permits better access for trucks and equipment and prevents rutting and breaking through the surface. Fewer holes and ruts also minimize standing water on the surface of the fill.

The tests show that the two-year-old incinerator ash residue tested is as good as, and better in many respects, than sandy clay earth for a sanitary land fill cover material. Experience shows that properly incinerated and conditioned ash less than two years old is also good cover material. In using freshly incinerated ash residue, it is important to achieve proper incineration to eliminate putrescibles and combustibles. Proper quenching is also necessary to insure that any combustibles not completely burned will be free from fire and that the material be cool and essentially odor free. In addition to proper firing and quenching, it is recommended that new incinerator ash be stockpiled in windrows for an additional period of about two weeks at the land fill site to further insure that the fire is out of the ash and that it is cooled properly. Proper placing of the windrows of the ash not only insures cooling, but also provides a desirable wind screen for the refuse being filled and makes an adequate quantity of cover material readily accessible for the daily covering of the filled material.

The other important consideration when using new ash for cover material is its proper placement on the refuse being filled. It is desirable to have the unoxidized tin cans remaining in the ash residue flattened in order to provide the desired compaction both at the time the cover material is placed and later when the cans oxidize. Experience has shown that the normal spreading and compaction process, with heavy equipment, provides the necessary flattening action on the cans and also provides the necessary compaction.

CONCLUSIONS

The use of incineration ash as a land fill cover material has many practical advantages in a total refuse disposal program. It allows the sanitary filling of waste land such as marshes, borrow pits, abandoned quarries, etc., where cover material is not available directly at the site without the costly purchase and subsequent hauling of clean earth. The use of ash also provides a reasonable method for disposing of the final portion of incinerated refuse in a manner that will benefit a municipal operation of combined incineration and land fill. In other cases the use of ash as cover material may allow the private land fill operator and the public agency, operating an incineration program only, to cooperate to the mutual advantage of both in the performance of a complete refuse disposal service.

ACKNOWLEDGEMENTS

Mr. William A. Xanten, Superintendent of Sanitation, Washington, D. C., provided valuable assistance in determining the procedures to be followed by Robb Tyler, Inc. in the operation of a modified sanitary land fill. Various Baltimore City and County officials cooperated fully in making the materials available for tests.

We specifically wish to thank Mr. Bernard L. Werner, Director of Public Works of Baltimore City; Mr. Joseph H. McCarthy, Sanitation Engineer of Baltimore City; and his Superintendent of Incineration, Mr. Victor A. Moore, for making the incinerator ash residue available.

We also wish to thank Mr. Charles E. Farley, Chief, Baltimore County, Department of Sanitation, for cooperating in the test of his sanitary land fill cover material.

REFERENCE

Ralph J. Black, Senior Sanitary Engineer, Public Health Service, U.S. Dept. of Health, Education, and Welfare. "Suggested Land Fill Standards and Methods," Refuse Removal Journal, October 31, 1961.

Re: Tyler Sanitary Land Fill

Results of tests requested in your letter of December 20, 1961 are listed below.

Loss on Ignition (dry weight)

10-yr.Ash Reedbird Ave.	Sandy Clay Batavia	2-yr. Ash Tyler
7.2%	1.5%	8.8%

Sieve Analysis

Sieve	Reedbird	Batavia	Tyler
2"	100	100	100
1"	98	100	93
¾"	94	100	87
#4	56	96	51
#10	36	94	37
#40	19	85	20
#200	8	31	8

Moisture Density

	Reedbird	Batavia	Tyler
Dry Wt.	102.5	122	100.5
Opt.Moisture	20	10.5	21

In-Place Density

	Reedbird	Batavia	Tyler
%Moisture	23.2	15.1	23.3
Dry Wt.	79.5	110.1	97
% Compaction	75.5%	90.0%	96.5%

Shrinkage Test – Saturated

Reedbird	Batavia	Tyler
1.1%	.6%*	.7%

*Shrinkage

Dry		
.6%	.4%	.1%

All dry measurements are shrinkage.

No evidence of cracking was noted in any of the samples tested. The material from Batavia did show approximately 1/32" shrinkage from the side of the mold.

Permeability

Both the sandy clay fill from Batavia and the cinder fill from Tyler and Reedbird show negative results and would be practically impervious.

PENNIMAN & BROWNE, INC.
Baltimore, Maryland