IRCWD NEWS

WHO International Reference Centre for Wastes Disposal

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Paper Chromatography, a Quick Method to Determine the Degree of Humification of Refuse Compost

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Introduction

The need for a simple and rapid method to determine the maturity of refuse compost has been felt for some time. A compost is considered mature, that is, ready for use, when no damage to plant sprouts and roots is noted in the seedling test as compared with the control.

The compost's applicability and extent of decomposition is determined at EAWAG on the basis of chemical and biological analyses and seedling test results. Although the C/N ratio, chaetomium count and seedling test offer indications of the processes which have taken place, they are time-consuming and require expensive technical installations and specialized personnel. A quick and sufficiently accurate method that will adequately characterize the degree of humification of the compost is therefore needed.

The paper chromatography method developed by E. Pfeifer, Director of the Biochemical Research Laboratory, Spring Valley, U.S.A., for the empirical characterization of various humus and compost qualities is based on the observation that materials in a common solution do not necessarily have the same affinity to a particular adsorbent. In short, it separates the three most important phases of humification into viz a) decomposition of raw materials b) synthesis of humins and c) mineralization.

Since paper chromatography supplies sufficient information for the purpose of compost production and use and since test results can be obtained within two to three days, this method has been tested at the EAWAG in numerous small scale experiments. It was shown that the development in stain patterns coincided with the progressing degree of maturity. The same stain pattern always corresponded to a particular degree of maturity irrespective of the material's age.

Procedure

The "reversed phase method" is applied to a round filter disk. The filter is pretreated with a developer ($AgNO_3$-0.5%) and dried under the exclusion of light. The compost sample is then dissolved in NaOH-1% through constant shaking for 5 hours. After having been left to decant for one hour, the solution is transported to the pretreated disk via a wick. In approximately 30 minutes the solution travels from the center of the filter disk to within 6 cm of the edge. Depending upon the type of material under examination, the solution will contain soluble humins in various concentrations and thus have a number of color tones. After it is left to dry for a number of hours in a subdued light, the pattern is fully developed and can be interpreted.

This method was tested in three experiments in which the procedure was held constant while the experimental conditions were varied. For each experiment about 60 kg of fresh, ground material was allowed to ferment. A weekly chromatography was made and the C/N ratio and chaetomium count determined.

Interpretation of the Chromatography

Depending on the material examined, stains of various colors develop. Each stain has three zones: the center, a middle zone r = 4 cm, and a peripheral zone r = 6 cm.

The color, shape and extention of the stain's zones are determining characteristics.

It was discovered that the presence in solution of larger amounts of material soluble in NaOH indicated a greater extent of humification in the compost-sample. The dissolved material has a strong affinity to paper; in other words, it does not spread readily on filter paper. The resulting zone is dark grey-brown in color. On the other hand, the solution containing non-degraded material is light and spreads rapidly over the paper. The middle zone is mostly light in color while the peripheral zone is darker. The center zone of a chromatogram of forest soil of high humic content (Fig. 1) has a number of colors; the middle zone is dark and the outer one light. The colors blend into each other without any sign of ring formation.

The stain resulting from non-degraded crude compost shows the reverse structure (Fig. 2). The center zone remains white, and the colors, separated by clearly defined rings, spread to the peripheral zone. There are no delicate lighter streaks or jagged edges.

During the humification process the center zone gets progressively darker, the peripheral zone turns lighter and the edges get more and more jagged (Fig. 3, 4, 5, 6). The color shifts from brown to grey with advancing degree of maturity.

The biological activity of the first phase of decomposition can be identified by the reddish tint in the middle zone and darker periphery. A red-violet middle zone with jagged edges and a lighter peripheral zone is a sign of mineralization. A similar structure is also found in soil to which a mineral fertilizer has been applied.

The following criteria can be used to classify compost by means of a chromatogram: (These criteria refer to plant seedlings, the most sensitive phase in plant growth).

Phase 1 — Decomposition of raw materials

White in the center, extended middle zone, ring formation. Seedling tests haven proven this material to be toxic (Fig. 2).

Phase 2 — Humin synthesis

This phase is considerably longer. The stage of development in the phase can be deduced from the regularity, number and jaggedness of the points, the way in which the middle zone discolors and the lightness of the edges. In seedling tests, composts beginning the second phase are still detrimental to the roots of plant seedlings (Fig. 3); in later stages plants grow well when the compost is mixed with soil (Fig. 4, 5). Plants can be grown on the final product without the addition of soil (Fig. 6).

Phase 3 — Mineralization

Reddish violet center zone with regular converging streaks and a lighter peripheral zone.

Mature sifted composts are often mixed with peat or other organic additives, packaged and sold. In the chromatogram the additives show up in the middle zone; this can have a number of colors, for example, yellow for the peat additive. Depending on how fine the quality, such composts are similar to soil improvers and are well suited for sensitive pot plants (Fig. 7).

This simple and rapid method is recommended as an excellent tool for the agricultural adviser.

Color photographs of the original chromatograms in the test series, test material from various sources and a more detailed description of test procedure (in German) are available at cost price.

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Chromatograms of Refuse Compost

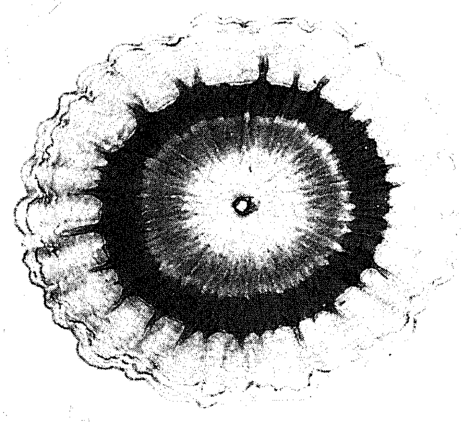


Fig. 1
Center zone of a chromatogram of forest soil. High humic content and a number of colors. Middle zone dark, outer one light.

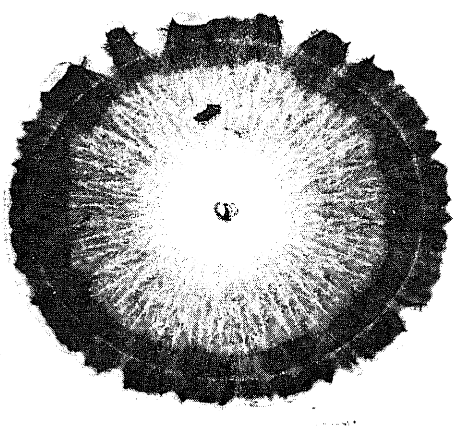


Fig. 2
Stain from non-degraded crude compost. Center zone remains white. Colors, in ring-formation, spread to the peripheral zone. Toxic to plant seedlings.

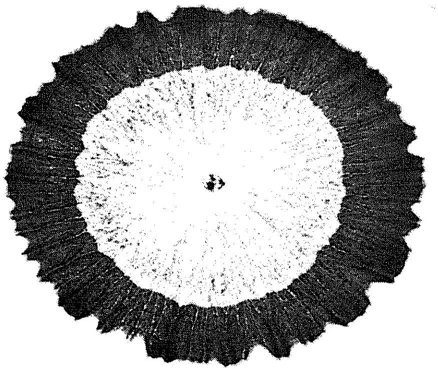


Fig. 3
Center zone darker, peripheral zone lighter, edges get more and more jagged during humification. The color shifts from brown to grey with advancing degree of maturity. Detrimental to the roots of plant seedlings.

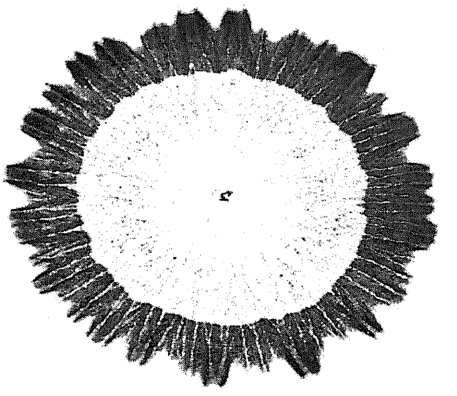


Fig. 4
Same as Fig. 3. When mixed with soil, plants grow well on this compost.

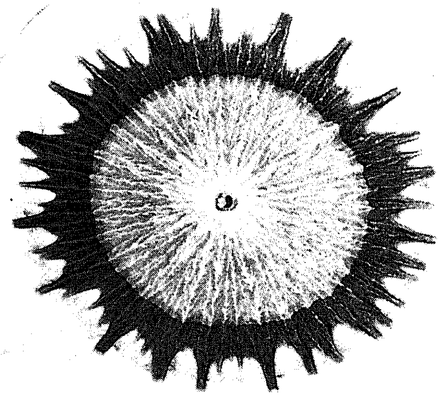


Fig. 5
Same as Fig. 3. When mixed with soil, plants grow well on this compost.

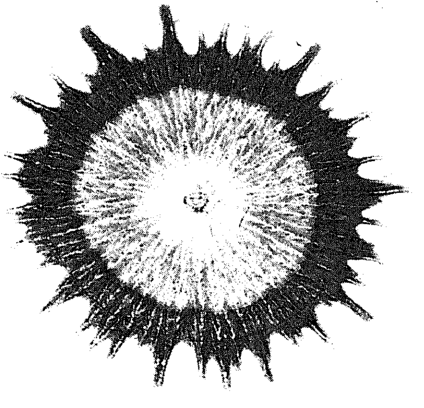


Fig. 6
Same as Fig. 3. Plants can be grown on this final product without the addition of soil.

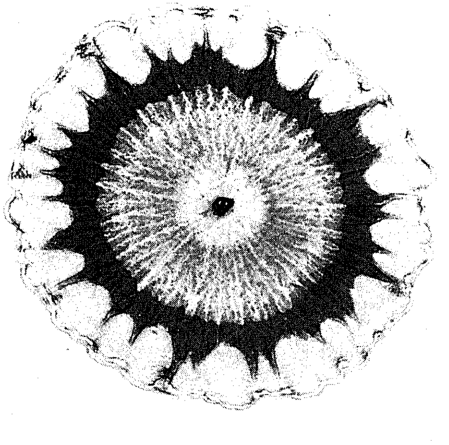


Fig. 7
Such a compost is similar to a soil improver and well suited for sensitive pot plants.

News from WHO

A WHO Expert Committee on Wastes Disposal (Disposal of Community Wastewater) met in Geneva from 25 September to 1 October 1973. Such a committee is established to deal with a particular subject and consists of a group of experts convened for the purpose by the Director-General of WHO on the basis of their special knowledge and experience concerning the subjects on the agenda. The meetings are open only to those expressly invited to participate. The Expert Committee on Disposal of Community Wastewater was attended by eight members. The International Association on Water Pollution Research, the International Bank for Reconstruction and Development, the United Nations Economic Commission for Europe, the United Nations Environment Programme, and the WHO International Reference Centre for Wastes Disposal were also represented. The Committee reviewed the most important community wastewater disposal problems in developing countries, discussed appropriate criteria for the planning, design and construction of wastewater systems, examined the principles that should guide national and community planning of such systems and their operation, and pointed to areas where developmental investigations are required. It also made a number of recommendations for action at various levels and stressed the vital rôle of WHO in the advancement and transfer of knowledge in this field. The report of the Committee was published in the WHO **Technical Report Series, No. 541** early in 1974.

The findings of a WHO survey of community water supply conditions in 91 developing countries and of sewage disposal conditions in 61 developing countries as of 1970 have been published in the **World Health Statistics Report,** 1973, Vol. 26, No. 11. Copies may be obtained at a cost of $ 5.25 from WHO Distribution and Sales Service or any of its sales agents.

A special Technical Panel on Rural Potable Water Supply and Sanitation met in Geneva from 7—16 October at the initiative of seven sponsoring agencies to develop a medium-term programme of technology transfer and applied research in this field. The Panel was made up of 15 specialists from 12 countries.
The Technical Panel's purpose was to develop a programme designed to overcome the problems of the application of existing technology, determine the best methods of transferring information and establish the need, if any, for further research in this area. In the last three days of its discussions, the Panel briefed seven experts on the scope, content and objectives of the programme. The seven experts — sanitary engineers and administrators — will survey institutes in Africa, Asia, Europe and Latin America to assess their technical capabilities, potential for expansion and abilityto co-ordinate and stimulate research and apply existing technology.
It is planned that the final recommendations of both groups will be presented to potential donor agencies, both governmental and private, who may take an interest in the implementation of the various recommendations made.

The Regional Office for Europe of the World Health Organization in collaboration with the Government of the Polish Socialist Republic within the context of the UNDP/WHO-assisted Project POL 3102 Environmental Pollution Abatement Centre, Katowice, convened a Seminar on the Design of Environmental Information Systems in Katowice, Poland, from January 11 to 20, 1973.
The main purpose of the seminar was to bring together experts from many countries to discuss the rational design of environmental information systems and to develop criteria for the establishment of such a system which could be of benefit to Poland as well as to other countries.
The following documents were reviewed:

A general approach to the planning of environmental information services;
Needs of environmental information for the Katowice Voivodeship;
The role of the Environmental Pollution Abatement Centre and its envisioned information service;
External sources of information;
Basic design of an environmental information system for EPAC, and finally, General recommendations.

The edited version of the papers presented at the WHO seminar are available in a book entitled "Design of Environmental Information Systems" and can be obtained directly from:
ANN ARBOR SCIENCE PUBLISHERS, INC.
Ann Arbor, Michigan 48106, USA
or through:
JOHN WILEY AND SONS, LTD.
Chichester, Sussex, England

WHO Collaborating Centre for Surface and Ground Water Quality

The Canada Centre for Inland Water in Burlington, Ontario has been recently designated by WHO as the WHO Collaborating Centre for Surface and Ground Water Quality. The main functions of this centre will be to assist WHO on research and technical matters regarding the measurement and monitoring of water pollutants, water quality criteria, environmental and health effects of water pollutants, and water pollution prevention and control measures, including the planning and implementation of water pollution control programmes. The Centre will provide consulting services, organize inter-laboratory comparisons, assist in the exchange of technical information and scientific data, and in the development of training programmes.

Periscope

"CEPIS" Lima

The following is a brief English summary of the document "General Information for Evaluation of Water Supply and Sewerage Programs in Latin America and the Caribbean" by eng. R. Sandoval, PAHO Consultant with the Economic Commission for Latin America.

General Information for Evaluation of Water Supply and Sewerage Programs in Latin America and the Caribbean

A document summarizing the progress made in water supply and sewerage programs in Latin America and the Caribbean from 1961—1971 is available in Spanish from the Pan American Center for Sanitary Engineering and Environmental Sciences, Casilla 4337, Lima, Perú. The document includes a compilation of statistical data on urban and rural population, percentage of population served by water supply and sewerage systems, and international and counterpart funds allotted to water supply and sewerage programs in 24 countries of the Region.

In the narrative which accompanies the statistical tables, various difficulties encountered by the countries in their efforts to reach the goals set in the Charter of Punta del Este in 1961 are pointed out.

For the decade 1971—1980, it is suggested that technical and financial aid priorities be given to the countries which remain the farthest from the goals set for the previous decade.

The new goals adopted by the III Special Meeting of Ministers of Health in 1972 include: a) Urban water supply — 80% of population served by house connection, or a minimum 50% reduction in the population without this service; b) Maintenance and improvement of urban water supply systems to ensure uninterrupted service, sufficient quantity and high-quality water; c) Rural water supply — 50% of population served, or a minimum 30% reduction in the population without this service; d) Urban sewerage — 70% of population served, or a minimum 30% reduction in the population without this service; e) Rural sewerage or other method of excreta disposal — 50% of population served, or a minimum 30% reduction in the population without this service.

The following strategy is suggested for the decade 1971—1980; a) Improvement of reporting systems for information on water supply and sewerage programs; b) Formulation of national and regional development plans which specify environmental goals and progress indicators; c) Strengthening of institutional infrastructure at the national level; d) Development of manpower resources through special training activities; e) Preparation of detailed pre-investment studies; f) Establishment of standards and quality controls; g) Development and/or adaptation of low-cost technology and administrative methods; h) Application of mass approach techniques and community self-help concepts in rural water supply programs; i) Use of revolving loan funds to finance rural water supply programs; j) Development of new methods of wastes management for rural communities and marginal urban settlements.

New Publications

The Central Public Health Engineering Research Institute (CPHERI) in Nagpur, India, has compiled a bibliographical review entitled "Research in Retrospect 1959—1973". The Institute's findings and publication output in the area of Public Health Engineering and allied subjects over the last 15 years are reviewed in this document. It also serves as a medium for disseminating information about the research carried out by the Institute. The Central Public Health Engineering Research Institute was renamed National Environmental Engineering Research Institute (NEERI) in July 1974.

The **Indian Journal of Environmental Health,** Vol. 15, No. 4, covers papers presented at the Seminar on "Environmental Problems Associated with Fertilizer Industry" on July 27, 1973. This Seminar was sponsored jointly by Central Public Health Engineering Research Institute, Nagpur, Fertilizer Corporation of India, Trombay Unit, Fertilizer Association of India, New Delhi and Indian Standards Institution, New Delhi.

The pollutional aspects of the fertilizer industry are presented and discussed in the paper along with treatment and disposal methods for liquid, gaseous and solid wastes. The costs of different pollution abatement schemes for the wastes from a typical fertilizer factory in the country are also discussed.

Abstracts

The following abstracts have been taken from our documentation on solid wastes which contains at the present moment over 2000 publications.

Mallan, G.M., Finney, C.S.: New techniques in the pyrolysis of solid wastes, 1972, American Institute of Chemical Engineering, 73rd National Meeting, August 27–30, Minneapolis, Minnesota.

The Garrett Research and Development Company has developed an integrated resource recovery system for recycling over 90% of the raw materials contained in municipal solid waste. A unique, highly efficient, flash pyrolysis process has been studied at a four ton per day pilot plant, and yields of more than one barrel of synthetic fuel oil per ton of "as-received" refuse have been achieved. The process operates at substantially atmospheric pressure, requires neither hydrogen nor catalysts, and produces a low-sulfur oil having a heating value equivalent to 75% of No. 6 fuel oil on a volumetric basis. A froth-flotation process has also been piloted for recovering over 70% of the glass at better than 99.7% purity. The results of these pilot plant studies, including power and maintenance requirements for all feed preparation subsystems, are discussed. Evaluation of the recycled products by potential customers has been completed, and the process is considered ready for immediate implementation. The economics projected for a complete 2000 TPD recycling plant suggest that the process could pay for itself under municipal ownership conditions when implemented on this scale.

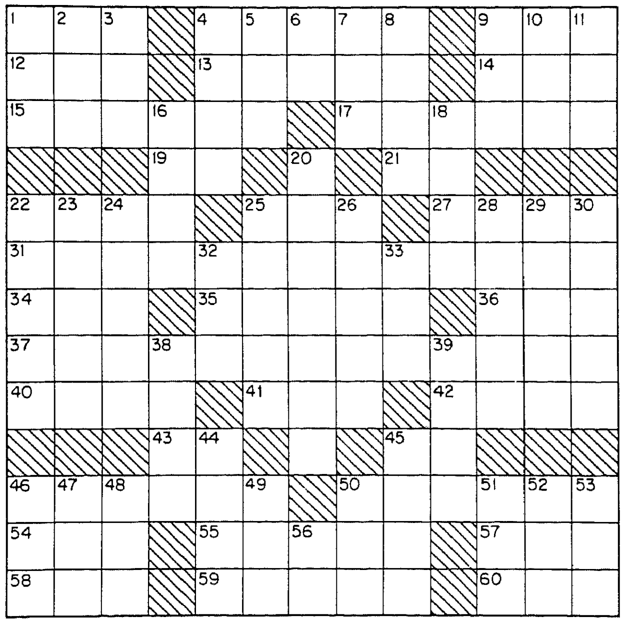
Anonymous: Pyrolysis of domestic wastes, Sept. 1972, 18, No. 9, 11p, Chemical Processing, London.

The development of a flash pyrolysis procedure that yields good quality fuel oil and saleable quantities of organic and inorganic materials is described. The process is almost a pollution-free means of converting solid waste to useful products and is a revenue-producing means of waste disposal. In addition, the method can be expanded into an integrated series of processing stages for the recovery of over 90% of the raw materials contained in municipal waste.

Appell, H.R., Fu, Y.C., Friedman, S.: Converting organic wastes to oil, 1972, 53, No. 3, 17–20, Agricultural Engineering (ETHZ).

The Bureau of Mines is experimentally converting cellulose and lignin, the chief constituents of organic solid waste, to a low sulfur fuel oil. Agricultural wastes, bovine manure, wood, urban refuse and sewage sludge have been successfully converted. This method requires reaction with carbon monoxide and water at temperatures of 300 to 400 C and pressures of 3000 to 4000 psig. Various catalysts and solvents are used. Cellulose conversions of over 90% (corresponding to oil yields of 40 to 50%) have been obtained. These experiments resulted from the Bureau's efforts to meet the growing energy shortage in the U.S. in keeping with the demands of good environment. Most previous work on converting coal to low sulfur liquid fuels used hydrogen at high pressures and high temperatures in the presence of a catalyst. In seeking a system not requiring hydrogen, the Bureau discovered that treating low rank coals with carbon monoxide and water converted them to a low sulfur, benzene soluble oil in good yields. At 350 to 400 C the reaction of coal with carbon monoxide and water is faster than the reaction of coal with hydrogen. To learn why this reaction was so successful, the reactions of several model compounds with hydrogen and with carbon monoxide plus water were carried out. Olefins, aromatics, etc., added more hydrogen in the presence of hydrogen gas. But with cellulose and lignin, the chief constituents of growing plants, the reaction with carbon monoxide and water was fast and essentially complete. Additional work showed that carbohydrates in general (cellulose is a carbohydrate) could be converted to an oil with carbon monoxide and water. Inasmuch as the major constituent of urban refuse (after removal of metal and glass) is carbohydrate, largely cellulose, the studies of the reaction originally developed for liquefying lignite quite naturally evolved into work on liquefying refuse and simultaneously helping to solve the solids wastes problem. The first experiments on urban refuse were successful and the work was rapidly extended to include a wide variety of organic wastes. It now appears that any waste which is largely carbohydrate, or contains some carbohydrate-type structures, such as lignin, can be converted to oil by reaction with carbon monoxide and water.

Pollution Puzzle



Across:

1. Industrious insect
4. Cleanse thoroughly
9. State on the southwestern coast of India
12. Common Market (abb.)
13. The monovalent hydrocarbon radical which forms the base of common alcohol
14. Small saddle horse
15. Precipitate in sewage tanks
17. Organic fertilizer
19. United States (abb.)
21. Miles (abb.)
22. Exclamation
25. Part of the alimentary canal
27. Type of package
31. Mechanical device for separating water from solid materials
34. Small town on the Caucasus in the Georgian Soviet Socialist Republic
35. Part of a coat
36. Cardinal number in Italian
37. Reconstitute
40. Institut National des Etudes Démographiques (abb.) (e = i)
41. Years (abb.)
42. Pigmented membrane (y = i)
43. Old English (abb.)
45. Measurement (abb.)
46. Surface within a furnace
50. Large tank in which water is turned to steam
54. World Health Organization (French abb.)
55. Water wheel
57. Associate of the Royal Academy (abb.)
58. Young dog
59. Active substance producing an effect
60. Mouselike mammal

Down:

1. Egyptian god of pleasure
2. Snakelike fish
3. French coin of the 17th and 18th centuries
4. Foot or leg (colloq.)
5. Member of a nomadic Indian tribe that lived in Colorado and Utah, U.S.A.
6. Rhodium (symbol)
7. Gymnasium (colloq.)
8. Ancient kingdom in Iran
9. African antelope
10. . . . fish
11. Epoch
16. Fine particles
18. Crushed coffee or cocoa beans
20. Approve
22. Before (nautical use)
23. Type of cloth
24. Springs in the Northern Territory of Australia
25. Of or like grapes
26. Plait of hair
28. In excited activity
29. Small town near Niagara Falls
30. Small town near the Eastern Frisian Islands
32. Hardy tree
33. In the Bible, a high priest of Israel
38. Usually unpleasant
39. Tree found in swamps
44. Volcanic mountain in Sicily
45. Type of ditch for protection
46. Climbing vine
47. Large, nonflying bird
48. Poisonous snake
49. Lover of compost
50. Garbage container
51. Abb. for an experimentation room
52. Period of time
53. Cleaner of waste
56. Rhenium (symbol)

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