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Expert Working Group Meeting on the
Manufacture of Chemicals by Fermentation

Vienna, 1 - 5 December 1969

# FERMENTATION AND WASTES DISPOSAL 1/

prepared by the

World Health Organization

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ID/WG.50/9 SUMMARY
4 November 1969

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SUMMARY

# FERMENTATION AND WASTES DISPOSAL 1/

prepared by the

World Health Organization

Amongst the residues of human life and activity are many fermentable substances and the wastes of fermentation industries. Wasted substances are naturally assimilated into the environment by various processes, including fermentation. Natural assimilation is limited, and when it is exceeded, nuisances and health hazards invariably result.

Protection of the public health requires as a minimum that wastes be safely confined and disposed of, and in some cases that they be suitably treated to prevent pollution of the environment. The wastes of the fermentation industries are in general amenable to biological treatment. Economic and social considerations lead to efforts to recover usable materials or to prevent wastes. Wastes management in developing countries involves planning simple, adequate facilities, geared to present, and possibly changing requirements. Industries must bear a fair share of the responsibility and cost of waste treatment and disposal.

WHO has been actively assisting member states to carry out relevant studies and to form competent staff and institutions. An International Reference Centre for Wastes Disposal was set up in 1968.

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Many municipal and industrial wastes, both liquid and solid, are organic and capable of decomposition. Under certain circumstances they may be discharged directly to the environment without nuisance. In large, rapidly moving streams, for instance, the biochemical mechanisms for disposing of organic wastes quickly adjust to small increases in organic load: growth of organisms is stimulated, oxidation increases and the loss of dissolved oxygen is made up for by increased reaeration[1]. Solid wastes "confined, compressed and covered" in sanitary landfills are gradually stabilized organically. Natural assimilation of wastes in water and soil plays an extremely important part in environmental engineering: first of all it does a large part of the job for us and secondly it demonstrates most of the basic processes which we have attempted to develop and utilize in wastes management.

In popular discussions of environmental protection it is sometimes forgotten that wastes must be put somewhere, within a reasonable distance, and that planned wastes disposal is a reasonable use for certain land and water resources. Metropolitan master plans should reserve adequate space for solid wastes disposal. The self-purification capacity of rivers should be utilized, and possibly boosted, by the use of flow regulation, as well as by barriers, pontoons or other aerating devices.

Organic wastes, however, are often putrescible and may contain pathogenic organisms. If natural purifying mechanisms are exceeded, nuisances and health hazards will inevitably result. This situation has, of course, arisen in many places due often to multiple causes. The measures needed to restore healthy conditions and the rational and equitable apportionment of financial responsibility for achieving those measures are subjects for expert study and should be fully understood by all the governmental bodies, individuals and industries affected by them.

To the public health engineer wastes management means, as a minimum, confining and removing wastes from immediate human surroundings and sometimes treating them to prevent health hazards or nuisances. In the fermented

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1 E. B. Phelps, Stream Sanitation, Wiley, New York, p.17

beverage industries 100 or 150 volumes of water are used for every volume of product. The strongest wastes of these industries contain from 2 to 7 per cent solids (mostly volatile) and have 5-day BOD values of 10 000 to 30 000 or higher. The waste of a large distillery may contain a BOD load equivalent to that of the domestic sewage of a town of 100 000 or more people. Such waste can seldom if ever be satisfactorily disposed of into a river without treatment. The wastes of other fermentation industries are also highly decomposable: although at present the quantities of wastes produced are small, the prospects of much larger fermentation industries in the future bring with them also the corresponding problems of larger quantities of wastes to be dealt with.

Fermentation wastes may often be conomically combined and treated with domestic sewage. The treatment of fermentation wastes is enhanced by the supply of micro-organisms and nutrients from the sewage, and the industry - especially a small one - is thus relieved of many worries. But if the industrial load is large, this will not only increase the size of needed municipal treatment facilities but may also cause some operating difficulties. In the UK, where municipal treatment of industrial wastes has been generally practised, fermentation wastes have been blamed for gas formation and refloating sediments in primary settling tanks, for excess acid formation in digesters, for growth of filamentous bacteria in aerators (thereby slowing post aeration settling), and for bulking in trickling filters. Pharmaceutical wastes may inhibit biological treatment processes[1].

The industry which is obliged to deal in part or in whole with strong organic wastes will first investigate the feasibility of recovering or producing salable products from them. The industry will also study carefully every means of reducing by good in plant housekeeping the amount of water used in processing and washing, and of decreasing by modified processes the total amount of waste water discharged. Lastly, the industry will plan for the treatment or pre-treatment of remaining wastes. During these studies consideration will be given to the possibilities of separating or combining strong and weak wastes, of storing wastes during periods of high production or low river flow, and of utilizing economically some of the treatment processes

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1 S. H. Jenkins, Sewage Purification and Trade Wastes, in "Disposal of Industrial Waste Materials" papers read at Sheffield University, 17 - 19 April, 1956, Soc. of Chem. Ind., London.

or equipment too costly for municipal sewage.

Organic solids have for years been recovered from distillery slops by back-slopping, screening and evaporation, and sold as animal feed or as fertilizer. In some cases the more profitable recovery of vitamin B complex has been realized. Such recovery has been practised by large plants on wastes containing at least 3 - 5% organic solids. The expansion of the fermentation industry and the increasing stringency of pollution control regulations will certainly result in increased research and new developments in this field.

Fermentation wastes containing organic solids of the order of 1 - 3% can most economically be treated by anaerobic digestion. Very little sludge is produced. BOD reduction varies from 70% for starch wastes to as much as 97% for distillery wastes. Methane gas produced during the process can be utilized to heat the digester. Two-stage thermophilic digestion for a total of 8 days was formerly recommended[1]. Recent experience shows good results at mesophilic temperatures in single-stage digesters provided with efficient means of gas removal and periodic sludge recirculation[2]. Apparently the biological process is completed within a few hours and the remaining time (6 to 10 days) is necessitated by hydraulic factors in the operation of the digester.

The digester supernatant, containing as much as 1 000 ppm 5-day BOD or more, and other dilute plant wastes are amenable to aerobic biological treatment. Trickling filters, activated sludge tanks and stabilization ponds are used successfully, if due precautions are taken to avoid the difficulties referred to earlier in connexion with municipal plants. Wastewaters may need to be seeded with suitable micro-organisms and provided with nutrients. This can often be accomplished by adding domestic sewage from the plant. The processes usually require a few days (or even weeks) of breaking in before they will operate smoothly[1].

Turning to the problem of wastes management in developing countries, several points must be emphasized. First of all, because of varying customs of personal and community hygiene and because of the greater

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1 E. F. Eldridge, Industrial Waste Treatment Practice, McGraw-Hill, New York, p.325 ff.

2 G. G. Cillie et al, Anaerobic Digestion-IV. The application of the process in waste purification, Water Research, 3 (Sep. 1969) p.623 ff.

prevalence of communicable diseases, primary attention must be focused on the way people handle wastes at the source - household, school or factory. Their way of life is in transition: food, clothing, houses, work and leisure are changing, and the amount and kind of municipal wastes will also change greatly during the next few years. Secondly, many communities have at present neither facilities for collecting and disposing of liquid and solid household wastes, nor the financial and organizational means to build and operate them. Thirdly, surface waters are generally not classified, but are used for all purposes and little is known of their quality. Fourthly, under these circumstances, simple, adequate wastes management facilities must be provided which are closely geared to present needs, but adaptable to possibly changing requirements.

Industries must bear a fair share of the responsibility and cost of wastes treatment and disposal. In the absence of municipal sewage collection and treatment facilities and stream quality information, governments will tend to apply arbitrary effluent standards to industries (preferably expressed in terms of total pollutional load rather than strength of effluent). In the long run, effluent controls should be evolved which are based on a reasonable apportionment amongst users of the stream's ability to assimilate waste. The establishment of a more rational approach to stream quality maintenance may be hastened by the co-operative effort of industry in putting its laboratory facilities and scientific personnel to work helping to carry out river surveys and possibly even training government staff.

In closing, I should like to mention that sanitary engineering staff and consultants of the World Health Organization have been actively assisting member states for over twenty years in carrying out studies and in forming competent staff and institutions to deal with wastes management problems. We are at present executing a number of UNDP Special Fund projects which comprise pre-investment surveys for long- and short-range planning of community water supply or waste disposal facilities in metropolitan areas. Studies currently under way include water supply and wastes disposal planning in Istanbul, Kampala and Jinja, Accra, Dakar, the island of Malta, and areas of Morocco, Ceylon and Surinam, and wastes disposal planning alone in Manila, Taipei, Ibadan and Bangui. Additional studies will soon be started in

Kathmandu, Abidjan and Teheran. In order to facilitate the exchange of scientific information on research and development in wastes management, an International Reference Centre for Wastes Disposal was established last year with the agreement and strong support of the Swiss Government at the Federal Institute for Water Supply, Sewage Purification and Water Pollution Control in Zürich. The Reference Centre is organizing a documentation centre and will undertake certain research and training activities. A number of Collaborating Institutions have been designated which have agreed to co-operate in the programme. Information on waste management, including industrial wastes treatment processes and research in this field, will in this way be disseminated through WHO to member countries. For our part, we in the WHO Division of Environmental Health are grateful for the opportunity afforded by UNIDO to take part in this meeting and to express in this way our interest in finding more sanitary and economic solutions to the problems of industrial wastes disposal.

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