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OBSERVATIONS ON THE GENERATION OF METHANE

by

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Shortly after the publication of SPC Handbook No. 13 on the recycling of animal wastes (available in French only) the author of the Handbook was invited to take part in an International Conference on "Science and Technology in the Service of Developing Countries", held at the UNESCO Building, Paris, in May 1976.

The Conference was the forum for a broad exchange of views between developing countries, (17 African countries, and 16 from Asia, South America etc.) and those providing technical assistance (22 European and North American countries). Energy production and the control of all forms of pollution were amongst the main topics. A particularly interesting technical discussion concerned the use, in developing countries, of solar energy based on photosynthesis and methane fermentation. This subject, presented by Mr Isman, coincides with the areas of interest of the Public Health Engineer and Waste Digester Specialist of the Commission.

Consultation between the two authors of this Circular at the conference has shed new light on differences in methods, and enabled a number of details to be clarified.

It should be mentioned at the outset that research in France has thus far focussed on a different procedure from that developed by the South Pacific Commission.

The French method was designed for processing of strawy manure - stable-litter steeped in excrement. Periodically the digester is completely emptied and refilled, both operations being conducted with forks or claws, (whereas in digesters in the Pacific the effluent - obtained from the cleaning of piggeries and poultry farms - flows in and

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out continuously).

The wet strawy manure is first placed in an open tank for aerobic fermentation lasting about one week. This duration can be considerably reduced (to less than 48 hours in some cases) by providing a system which blows air into the bottom of the tank.

The main purpose of pre-fermentation is to eliminate the risk of acidification imparing the subsequent methane-producing fermentation. A further advantage is that the contents of the tank can quickly be heated to 70 or 75 ^{o}C; at this temperature, many parasites and pathogenic germs are killed, reducing the risk of pollution. In addition, when the substance thus formed is subsequently flooded with liquid manure containing methane bacteria, and the tank closed, aerobic fermentation can start with highly active thermophilic bacteria at a temperature of around 55 ^{o}C. Maintaining a temperature of this order is no doubt difficult in Europe, but can be achieved fairly easily in most tropical areas.

Daily gas output increases sharply at the beginning, then decreases gradually after reaching a peak. The duration of the complete cycle varies according to the temperature at which anaerobic fermentation occurs. It has often proved, in practice, to be approximately one-and-a-half months. Prolonged trials conducted by KOVACS at Gödöllö University of Budapest (Hungary) showed that optimum results were achieved with three to four days of aerobic pre-fermentation, immediately followed by four weeks of anaerobic fermentation (in this case at a temperature of 35 ^{o} with mesophilic bacteria).

For the purpose of the trials, a series of eight concrete tanks, each of a capacity of ten m^{3}, was used to process the manure produced by 60 to 70 head of large cattle.

Production ranged from 1 to 1.5 m^{3} per animal a day, and amounted to over 400 m^{3} per cubic metre of tank capacity per year.

The liquid manure recovered after fermentation is used as a leavening agent to activate a further tank-load, and the remaining drained solid matter as a normal fertilizing additive.

Thus, the entire fermentation cycle can occur in a single tank: however, to accommodate farm effluent arriving in a continuous stream, and to stabilize gas output, a series of tanks loaded by rotation must be used. Though this may at first sight appear to be a drawback, the system is in fact far more reliable than a single digester.

Thus, two distinct systems are available to date; their applicability and avantages differ.

The system used in the Pacific can be made to operate with relatively inexpensive neoprene bag-type digesters, and with a continuous input. On the other hand, it involves risks of fermentation failure, formation of clots, scums, crusts, and deposits, and in addition only sludgy liquid can be processed.

The second method requires greater initial outlay. However, this is offset by its ability to process a very wide range of organic vegetal wastes (a feature often recommended by the Waste Digester Specialist and the Public Health Engineer of the Commission), without incurring any of the risks mentioned above. Though cereal mulch or hay may

not necessarily be available it is generally possible, in most of the Pacific Islands, to find mown grass, fallen leaves, kunai (wild straw), water hyacinths, vegetable peelings, etc.

A further point worth mentioning is that aerobic fermentation is odourless, does not attract flies, and can if necessary be conducted under a protective wire-mesh cover, or even in a closed tank provided that it is suitably ventilated.

For the moment, each of the two methods meets distinct needs. It is however possible that by combining features of both a system responding adequately to all requirements will be found.

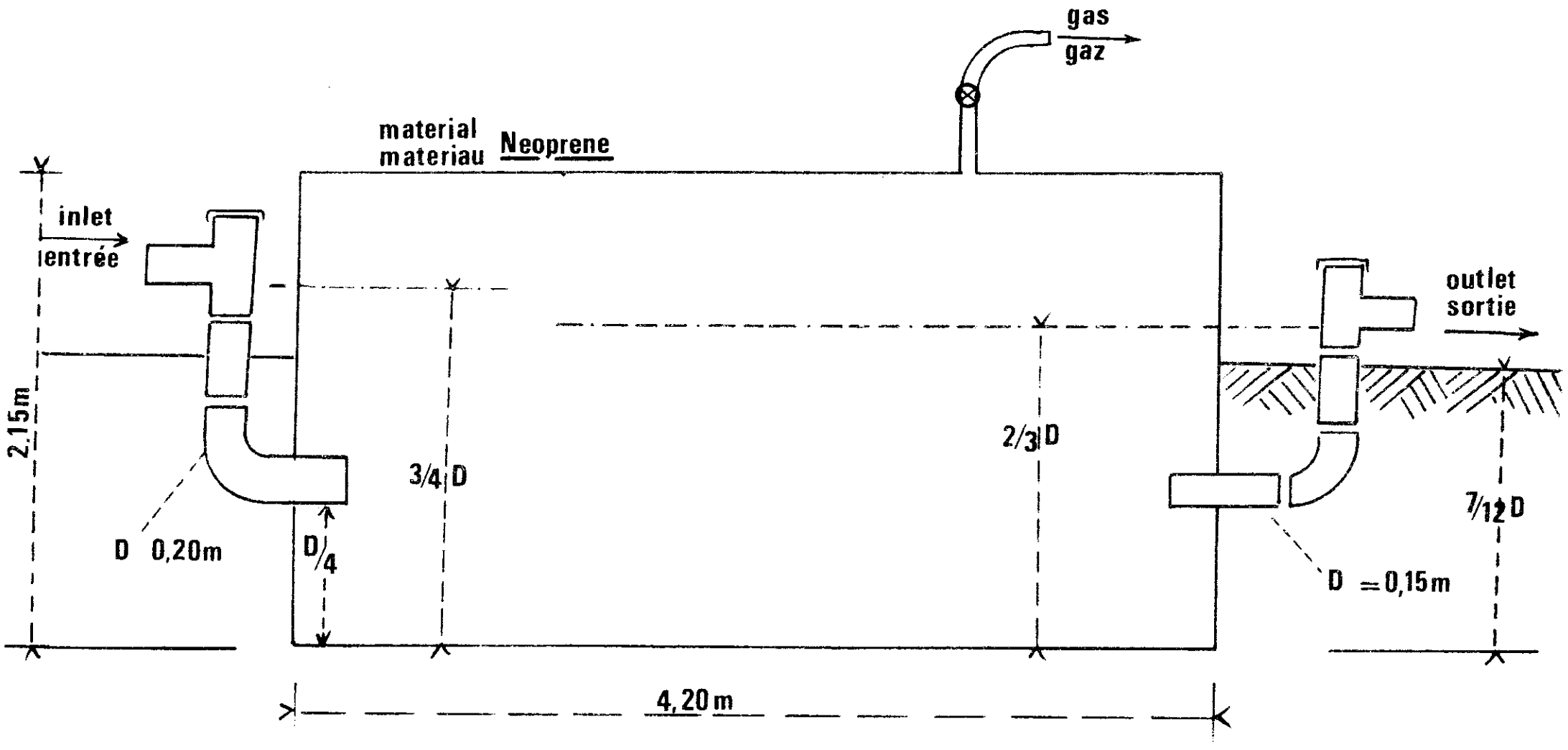
Concerning the use of the gas, it was pointed out at the Paris Conference that biogas is relatively easy to purify, and can in addition be used directly in conventional appliances running on natural gas. Larger consumers would be justified in compressing the gas for storage in cylinders. Purification concerns only CO_2 (generally 30 to 35 % of biogas). It is important to note that there is no H_2S provided that prefermentation is sufficiently thorough; it is in any case even more soluble than CO_2, and would therefore be eliminated during washing of the gas.

The conclusion to these remarks on the production of methane from organic matter which, in its raw state, is an undesirable polluter of nature, is that the experimental phase is to continue in a great number of countries, without, however, being divorced from practical aspects which have already been put to widespread use in certain parts of the world - Asia and Africa in particular. It is encouraging to note that farmers on all levels are putting findings into practical application without waiting for the inevitably delayed official publication of results. A fine example is a small-scale rabbit breeder near Paris, who already has a fully operating installation.

The role of the officers of the Commission, in collaboration with research workers and technicians from the territories and countries in the area, will be to work towards improvements in the various systems, adapting them to conditions in the South Pacific.

BAG-DIGESTER
DIGESTEUR SOUPLE

Cap.: 15 m^3



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