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THE BACTERIOLOGICAL QUALITY OF DIGESTATE PRODUCED BY THE METHANE-PRODUCING PROCESSING OF HOUSEHOLD REFUSE

The anaerobic digestion of household refuse by the VALORGA process produces an organic ameliorator (referred to as refined digestate) which is extensively used in agriculture.

Given the origin of the raw materials used, which generally contain a large amount of potentially pathogenic microorganisms, it is essential to evaluate the health risks involved in the use of this digestate. At the request of AFME and ANRED, a bacteriological study was entrusted to us within the context of an overall appraisal of this new method for processing municipal solid waste at the La Buisse site near Grenoble (Isère department).

For this, a number of groups of bacteria indicating fecal pollution and possibly pathogenic bacteria which are initially always present in fresh household refuse were sought systematically 14 times over the past three years.

The total number of **coliform bacteria** in household refuse is fairly steady at about 10^7 per g. Treatment reduces the population by 10 000 to 100 000 times in the digestate. There are never more than 1000 **fecal coliform bacteria** per gram.

The number of aerobic-anaerobic **fecal streptococci** does not decrease greatly during anaerobic digestion. It is between 10^4 and 10^7 per gram.

Clostridium perfringens, a sporulated, strictly anaerobic germ found in large numbers in solid and liquid manure is also

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found in household refuse at 10^4 to 10^5 germs per gram. This population is generally reduced by a factor of 10 in the products sold.

Salmonella are always present in household refuse. The number decreases considerably during the anaerobic digestion process. Although these bacteria were found three times in effluent sludge, they disappeared during storage prior to marketing. No *Salmonella* have been found in fresh digestate since January 1986. This might be related to the optimisation of the fermentation parameters.

Pseudomonas aeruginosa; an ubiquitous, opportunist pathogenic germ is also found in household refuse (at an average of 10^4 per g). It has never been detected in pressed effluent, but a slight recolonisation (about 100 germs per g) is sometimes observed.

The population of *Staphylococcus aureas*, which is very abundant in household refuse at an average of 10^6 per g, is reduced by 1000 to 10 000 times during digestion. In addition, these germs are eradicated as soon as the fermentation conditions have stabilised.

Although the methane production process helps to considerably reduce the number of infectious germs, it does not eradicate them totally. However, the presence of a few pathogenic germs or microbiological indicators does not *a priori* mean that a health risk is involved in use of the digestate.

Indeed, the survival and virulence of pathogenic germs depends on numerous intrinsic factors such as the type of microorganisms concerned, their numbers in the product in

question, their virulence (which in turn depends on environmental conditions and the time they stay in the medium), and extrinsic factors such the way in which the substance is used and the site of use, and the accompanying climatological and pedological factors, without forgetting data on the human or animal populations involved.

Finally, from a bacteriological point of view and in the light of the results of our study, agricultural use of the digestate involves no more risks, or perhaps fewer, that the use of animal manure.

Villeurbanne, 12 July 1987

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EVALUATION OF FECAL POLLUTION INDICATORS AND SEVERAL POTENTIALLY PATHOGENIC BACTERIA IN HOUSEHOLD REFUSE AND IN MARKETED REFINED DIGESTATE

Average values of 7 samplings under stabilised conditions from January 1986 onwards

	Raw household refuse	VALORGA digestate
Total coliform bacteria (number per g of product)	$10^7 - 10^8$	$10^2 - 10^3$
Fecal coliform bacteria (number per g of product)	$10^5 - 10^6$	$10^2 - 10^3$
Fecal streptococci (number per g of product)	$10^6 - 10^7$	$10^5 - 10^6$
Clostridium perfringens (number per g of product)	$10^4 - 10^5$	$10^3 - 10^4$
Salmonella (presence in 10 g)	+++	nd
Staphilococci (number per g of product)	$10^6 - 10^7$	nd
Pseudomonas aeruginosa (number per g of product)	$10^4 - 10^5$	nd slight subsequent recolonisation possible

nd = not detectable