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CATTLE WASTE PROBLEMS IN MADRAS METROPOLITAN SEWER SYSTEM - A PRACTICABLE SOLUTION

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INTRODUCTION

Public sewer systems are intended to carry only the liquid wastes from dwellings like the toilet wastes, bath wastes, kitchen washings etc. At any rate, they are not intended for carrying animal wastes and solid refuse. The situation in the city of Madras in South India however presents a complex ingress of all these wastes into its sewer system, causing quite some problems by way of sewer blocks.

The severity could be understood by the fact that an intense sewer block with the consequent backing up and overflow of sewage through manholes etc. are not uncommon at least once every week in certain locations.

A detailed evaluation of the mechanism of these cloggings revealed that the one major factor is the ingress of cow and buffalo dung into the sewer system washed into it from the many cattle sheds in the city. Further evaluation of the nature of quality variations in the sewage revealed the increase of its organic content also.

Details of these evaluations and a practicable remedy as tried out successfully by the interposing of a diaphragm (Settling)Chamber are presented in this paper.

THE MADRAS CITY AND ITS SEWER SYSTEM

The city of Madras is spread over an area of 130 square kilometers. It has a population close to 3.5 million. It is situated on the East coast of India in Latitude 13° 04' North and Longtitude 80°15' East. It has a warm moist climate of the tropical maritime monsoon type. The mean temperature is 33°C in summer and 18°C in winter. Relative humidity varies from 65% to 80%. The mean annual rainfall is 127 centimeters occuring over a total of 60 days mainly during the Northeast monsoon period of October to December and to some extent in the Southwest monsoon period of June to September. Thunder and cyclonic storms are rather common during these periods and have been recorded at speeds close to 130 Kilometers per hour in the past. The entire area is relatively flat.

The sewer system installed during 1910 has been steadily improved and expanded and as of now it has about 1100 Kilometers length of stoneware and cast iron sewers with about 25,500 manholes and 54 sewage pumping stations. The flat terrain and high water table necessitate a large number of relay sewage pumping stations. These pumping stations divided into five zones relay and funnel the city sewage of nearly 230 million litres a day into the zonal sewage treatment plants three of which have been completed and two are being taken up.

The sewers are designed for a minimum velocity of 0.9 metres per second at full flow for the smaller laterals and 0.76 meters per second for trunk sewers and major gravity lines.

The sewage pumping stations are traditionally operated manually and do not effectively control the surcharge in the sewer system. Automation of these pump operations and installation of higher duty pumpsets are now being provided in about 15 of the more critical pumping stations under a funding programme of the International Development Association to the tune of Rs.50 million. Sewer cleaning has been traditionally handled by manual labour with long bamboo splits for piercing the blocks and later removing them by buckets with the help of labour. Recently however, these are being obviated by the use of rodding and bucket machines. A vactor jet rodder is the recent addition to this fleet.

THE CATTLE DUNG PROBLEM

Among other ills which are incidental to any overloaded and old sewerage system in a developing society, the one problem which has been identified as causing the most severe bottleneck in terms of effective operation of the system has been the ingress of cattledung into the sewers from the nearly 1,500 licensed and a significant number of unlicensed cattle sheds in the city. Each shed accommodates about 4 to as much as even 16 cattle in a cramped location. By law, the shed owners are required to construct a holding chamber which would seggregate the solid matter from the cattledung wastes and allow only the liquid effluent to flow fast into the street sewer.

But, in course of time due to the conflicting pressures of life in a fast crowding urban set up in Madras, as in any other society under similar socio-economic stresses and strains, these chambers were not effectively provided and supervised and were conveniently put into intentional disuse by

the shed owner and the entire gamut of the cattledung gets conveniently washed into the street sewers. When effective supervision was clamped, it only ended up in the surreptitious dumping in of the cattledung during certain parts of the day by these shed owners

This situation has grown to such major proportions that almost a weekly clogging of a street sewer by the dung and consequent backing up and overflow of sewage into the road from upstream receptacles are not uncommon as of now in certain cattle-dense areas of the city. By a tentative cost projection, the labour and materials needed to periodically attend to these cases of sewer blocks computes close to Rs. 18 million annually.

MECHANISM OF CLOGGING BY CATTLEDUNG

The feed given to most of the cattle in these sheds is mainly paragrass grown in the City's peripheral sewage farms and dried straw. The grazing of the cattle in green pasteurs is only a dream for these animals. Further, by nature, these animals do not straightaway digest the feed and merely ingest it in the first instance and the feed undergoes a detention in its body awaiting digestion. When a more tempting feed is made available to the animal, it merely pushes out the earlier ingested feed without completing the digestion. As such, the fibrous matter like straw and stems of grass get tightly bound into a composite mass with the dung and unbroken by the scanty water used for washing these, they enter the sewers as miniature plugs and soon conglomorate to become a lumpy block.

Moreover, the time of such dung washings is invariably after the peakflow has already passed through the sewers in the mornings or before the rather low peakflow attempts to pass through the sewers in the evenings. Inevitably, over a few days interval, the plugging becomes so complete that sewage backs up and overflows causing public harm.

OTHER EFFECTS OF CATTLEDUNG

In addition to causing the sewer blocks, the cattledung has been found to increase the organic content of the sewage. The 5 day 20°C Bio-chemical oxygen Demand (B.O.D.) of the sewage has a mean of 315 mg/l with a standard deviation of as high as 65 mg/l as compared to a mean B.O.D. of about 250 mg/l with a standard deviation of 20 mg/l for sewage from a nearby comparison habitation with no cattledung ingress in its sewage.

The ratio of the chemical oxygen Demand (C.O.D.) to B.O.D. for the city sewage is about 3.3 as compared to about 2 for the sewage free from the cattledung ingress.

The Total and soluble Tannin & Lignin content for the city sewage is 47.5 and 38 mg/l as compared to 5 and 2.5 mg/l for the sewage free from cattledung ingress.

These increases in the organic content of the sewage warrants additional investments in the treatment of the sewage as caused by an increased oxygen demand and a retarted reaction rate.

Moreover, the anaerobic digestion of the cattledung that proceeds in the sewers releases its own end products of Methane and Hydrogen sulphide gases which are super saturated in the sewer atmosphere and damage the sewer surfaces.

SOME POSSIBLE REMEDIES

One remedy for the problem is a long term goal of moving the cattle away from the city and involves the rehabilitation of the people whose life and social survival are tied up with the city and their transplantation to faraway locations. This would take time. Some cities in India like Bombay & Bangalore have however achieved this by initiating the programme fairly early. At Madras this would take time.

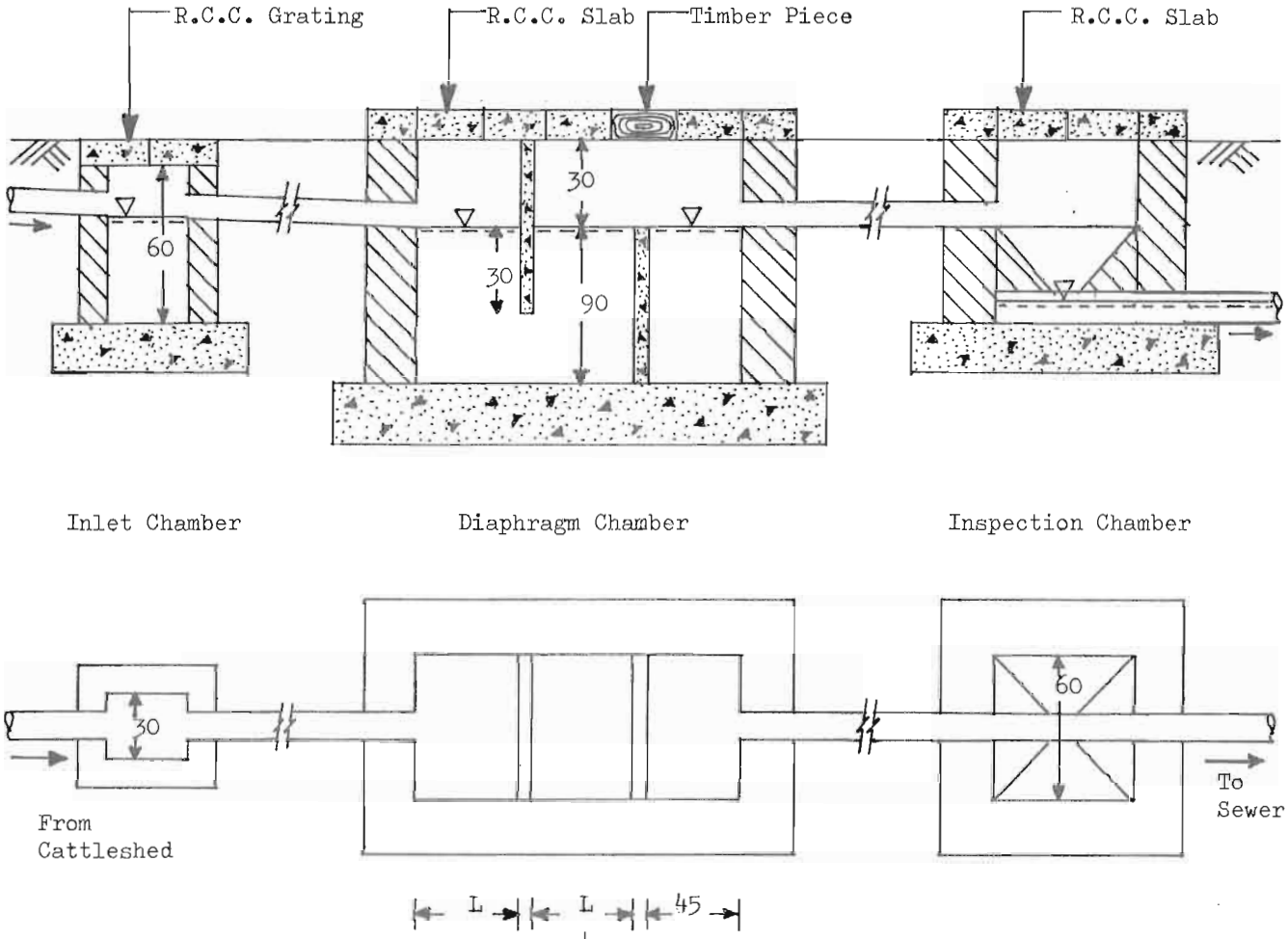
Among some of the other remedies which could be thought of to obviate the cattledung problem, the logical one would be to remove the dung at the source. This needs a virtual parellel conservancy system to be operated in the entire city with a possibility of using a central or regional cattledung digestor as an incidental energy source as well. Such programmes invariably would need a capital governmental funding and take time to come through.

An alternative for this would be for each of the shedowners to put up his own digestor and use the dung as a fuel source. The problem here, in most locations in the city are lack of adequate space and the absence of adequate water for rendering the dung into the requisite slurry.

This leaves the only possible alternative of installing a suitable diaphragm chamber so that, atleast the solid matter could be separated out and periodically removed instead of a daily removal as would be needed under the foregoing alternatives.

RESULTS OBTAINED WITH THE DIAPHRAGM CHAMBER

After studies of the nature and variations of flow from selected cattlesheds and applying the known principles of solid liquid separation, a practicable and simple to construct and operate type of diaphragm chamber was evolved and is shown in Fig.1. In essence, it represents a three compartment chamber with an initial underflow and subsequent overflow baffles as creating the three compartments in a masonry rectangular tank. The sizes would vary depending upon the number of cattle.



For Cattle Strength	0-10	30
" " "	10-20	45
" " "	20-30	70
" " "	30-40	90

FIG.1. TYPICAL DIAPHRAGM CHAMBER ARRANGEMENTS (Dimensions in Cm)

This chamber was installed at a cost of Rs. 1,800 in a shed with 20 cattle hitherto letting out all its wastes into a 225 mm street sewer. Operational results over a four month period indicate a reduction in settleable solids from 30% in the shed washings as entering the chamber to about 2% in its effluent. Cleaning of the chamber to arrest carryover was needed once in seven days.

During this period, there was not even a single sewer block in this street, which used to witness a near ritual of atleast one block per week prior to the installation of the chamber. The savings consequently, on labour and materials was about Rs. 8 per month.

Cleaning of the chamber has to be carried out by the cattleshed owners and so this requires a social awareness and commitment on their part, to ensure the success of this facility.

By a theoretical comparison, the capital cost for installation of Diaphragm Chambers in all the city's cattlesheds is around Rs. 5.3 million as compared to an annual cost of Rs. 18 million for sewer cleaning.

INFERENCES

The obviating of the cattledung problem in Madras sewers could be either by removing the cattle away from the city or by living with the problem in a less hazardous way.

Some alternatives like in place inceneration of the dung & use as farm compost is not practicable due to limitations of space and fuel scarcity.

An immediate practicable alternative is the provision of diaphragm chambers as presented in this paper.

The study reveals that, technology for developing countries has to be tempered with prevailing social and economic settings of the region & could be successfully implemented.