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THE BUILDING OF LATRINE CONNECTED WITH A BIOGAS DIGESTER AND IT'S SANITARY EFFECTS

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The latrine is important facility to a city.It is closely related to the people's health and appearance of a city. So it is required to be arranged reasonable, convenient to people, pleasing to the eye as well as easy to be cleaned and not to pollute the environment. For this purpose, a latrine connected with a biogas digester was built in Mianyang City in September,1981, and its sanitary effect was observed for more than a year. The results are as follows:

The design and construction of the latrine connected with a biogas digester

1. The latrine

The latrine is located at a residential quarter with 350 inhabitants. It occupies 60 m^2 with a concreta level roof and brick walls. There are 12 squats, half of them for men and half for women.Each squat has a upset ladder-shaped maggot-preventive concrete board,under which there are 5 maggot-preventive lines.The slope angle of the slide ditch for excreta which under the squats is as large as 45 degrees.

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In the wall behind the squats, there are ventilation pipes which connected with the chimney used for expelling offensive odour. The chimney is 1 m^2 and extends 2 m higher than the roof of the latrine. In the chimney, the plastic screen is inserted to protect the flies if any to fly out after laying eggs on excreta. There are some windows on the upper parts of the wall and some shutters on the lower for ventilation.

2. The biogas digester

The buffer tank is located between the slide ditch and biogas digester. It is 1.5 m^3 in capacity. The biogas digester is vertical circular in shape with fixed-dome, 22 m^3 in volume. It is composed of (1) a feeding chamber-including inlet and feeding pipe,(2)a fermentation tank including fermentation chamber and gas storage,(3) outlet pit and hydraulic chamber, (4) movable cover, (5) a gastube. In the fermenting tank, there are two semi-curve partitions which divid the tank into three small parts.There is only one tube through the middle of each partition with a certain angle. The lower end of the tube is pointed to the first part, and its upper end is to the second part. The middle layer slurry in the first part flows into the second one, then the third one and the storage pit through the tube. So,the flow course of excreta is as follows: Slide ditch under squats ⟶ main slide ditch⟶buffer tank⟶first chamber⟶second chamber third chamber⟶storage pit.

The slurry in the digester is only human excreta and some seeding materials taken from other digester, winery may also be added. The daily excrement and small amount of flushing water from the latrine feed into digester automatically.

The biogas is conducted by a conduct pipe and through a wet flowmeter. The gas produced has been recorded. The total

amount of biogas is about $40m^3$ per month. The maximum amount of gas production may be $1.9m^3$, the minimum $0.82m^3$, and the mean $1.1m^3$ per day.

3. The assessment of the hygienic effect

A new latrine connected with a biogas digester was used as an experiment latrine, and a new ordinary latrine with a storage pit as control.

(1) The measure of "three prevention" effect

a. The effect of preventing flies

In the period of May to October, 1982, the Flycages with putrid food in it were put in both latrines, 2018 flies were caught in experimental latrine altogether while in control latrine, 6,160 flies were caught, an 305 % increase over experimental one. In species of flies, 72.4% of Chrysomyia , 68.3% of Lucilia, 63.6% of Musca, 7.8 of Sarcophage, 8.3% of others less than that in experimental latrine.

b. The effect of preventing maggot

Only 64 maggots were caught in experimental latrine altogether within six months. The mean number was 10.6 maggots per month, but in control latrine, 1,137 maggots were caugh. The mean number was 189,5, 18 times higher than in experimental latrine.

c. The effect of preventing offensive odour

D.C. - 1 type of air sampling meter was used to collect the air in both latrines. The ammonia concentration in experimental latrine was 1.09-11.1 mg/m^3 air. The monthly average was 1.32-3.82 mg/m^3 air. In control one, it was 1.8-33.3 mg/m^3 air. Monthly average was 2.09-12.67 mg/m^3 air, 1—3 times higher than in former.

(2) The effect of disposal excreta by biogas digester

a. The reducing rate of parasitic ova

Samples were taken from digester once a month for 12 times altogether. The ova number in the samples of buffer tank was 107-2,050/ml. The average number was 1,158/ml monthly. But in storage pit it was only 0.5-197/ml. The monthly average number was 54.4/ml and it was 95.3% less than in the former.

b. The fatality rate of Ascaris ova

The average fatality rate of Ascaris ova in the samples of slide ditch was 12.5%, that in buffer tank was 65.2% and that in storage pit was 93.7%.

c. The Colititer examination

Most of the Colititer of the samples of buffer tank was 10^{-7} to 10^{-5}, and that of the storage pit was 10^{-5} to 10^{-4}.

d. The estimation of free ammonia and total nitrogen

The free ammonia was 0.33g % in the samples of buffer tank, and 0.36g% in storage pit. The total nitrogen was 0.51 % in the former and 0.49% in the latter.

e. The estimation of total solid and volatile solid

The total solid was 1.48g% in the samples of buffer tank and 1.46g% in storage pit. But the volatile solid was 0.62g% in former, o.64g% in latter.

Conclusion

According to the situation that in most of our small cities and towns, there is still no complete water supply and wastewater treatment system available. The latrine then plays an important part in sanitary facility. Since the 50s various kinds of latrine have been designed and examined. But the latrine connected with a biogas digester mentioned above has shown its advantages in preventing flies, killing parasitic eggs and disposing excreta.

It is important to point out that the storage pit of ordinary latrine can only collect and store the excreta for a short time, and have nothing to do with the disposing of excreta which is the source of various diseases. The environment may be polluted by those undisposed excreta when it is used as fertilizer.

But the latrine connected with a three-stage fermenting biogas digester can not only collect but also dispose the excreta. After anaerobic fermentation, the effluent flows from the fermenting tank of biogas digester into storage pit. The number of parasitic ova in the effluent reduced remarkably, the fatality rate of Ascaris ova reached 93.7%, and the Colititer was 10^{-4}. The hyginic effect could meet the requirement of sanitary regulation for the disposing of excreta in our country.

The experimental latrine is comparatively simple, cheap and practical in architecture point of view. Furthermore, the production of biogas and fertilizer of good quality enhances its economic value. It is worth studying and popularizing though further improvement is necessary.