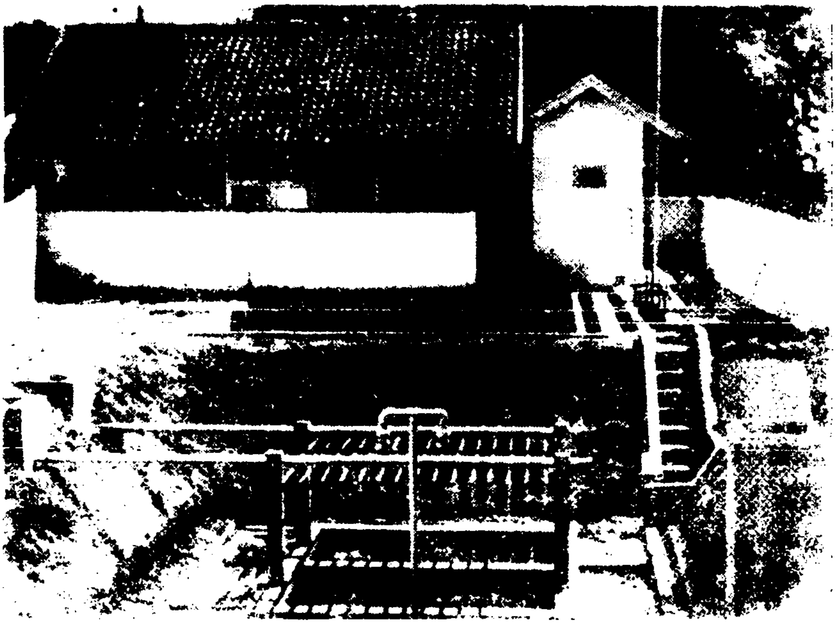
CIKAPAYANG

WATER PURIFICATION FOR VILLAGES USING THE IRON RUSTING PROCESS



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18-8-'83
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PROJECT OBJECTIVES

Up to now clear water has been provided for urban areas in Indonesia, but according to government policy (as expressed in the Eight Paths of Equity) clear water should be provided for rural areas as well.

There are many villages in Indonesia that are too far from urban centres to be connected to main water supply systems, but nevertheless need clear water supplies to raise health standards and the quality of life. These villages require self-contained systems that :

- Can be easily and cheaply constructed
- Can be operated by unskilled local people after a little training
- Are cheap to run and maintain
- Meet World Health Organisation and Indonesian Health Department Standards for clear water.
- Will not distrub the other uses of water in rural areas, for instance for irrigation

The Directorate of Building Research has set out to develop just such such a system and the Cikapayang installation is the result. Cikapayang fulfills all the above criteria and has the added and unique advantage that it uses cheap, readily available local materials, namely scrap iron and lime, DBR has set up a pilot plant in Bandung, using the water from the Cikapayang River, from which the system takes its name. The objective of the pilot plant scheme is to test the system, to make improvements if possible, and to make it ready for introduction into the villages of Indonesia.

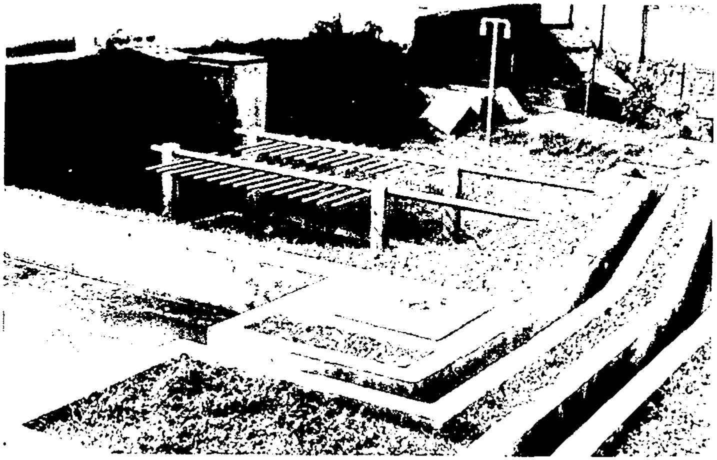
People using untreated river water

PROJECT STATUS

This project has been completely paid for through the Indonesian National Development Budget.

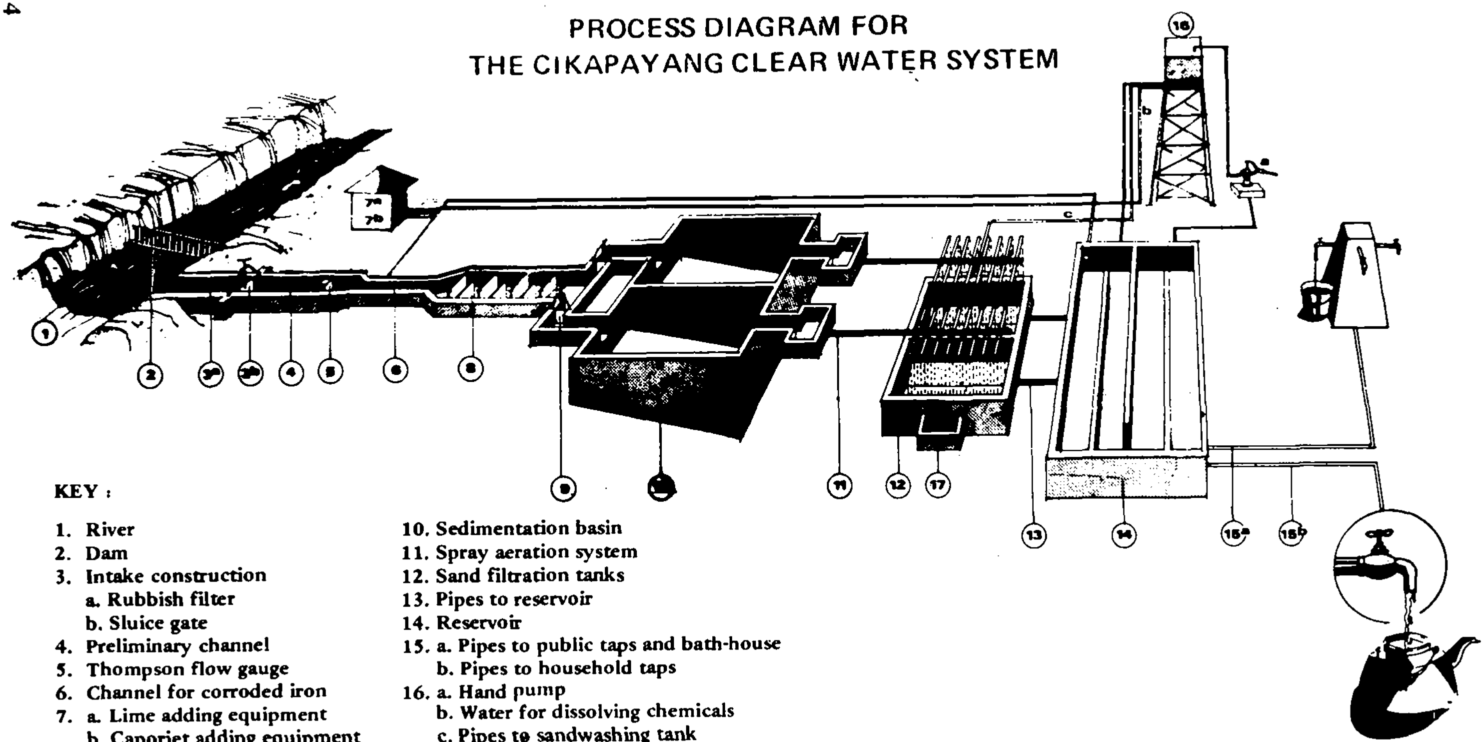
PROGRAMME FOR IMPLEMENTATION

- Construction of the pilot plant began in 1974 and was completed in 1975.
- Operation of the pilot plant began in 1975.
- To date through daily testing of input and output water has been carried out. Bacteriological tests have been carried out on a monthly basis by both the Indonesian Department of Health and the Department of Sanitary Engineering at the Institute of Technology, Bandung.
- At present a further pilot plant is under construction in a transmigration area in Bengkulu, Sumatra, and investigations are under way into the feasibility of using the Cikapayang system in batallion field headquarters and other places where rivers are the only sources of water.



Water goes from the sedimentation basin to the sandfilter via the aeration system.

PROCESS DIAGRAM FOR THE CIKAPAYANG CLEAR WATER SYSTEM



KEY :

1. River
2. Dam
3. Intake construction
   a. Rubbish filter
   b. Sluice gate
4. Preliminary channel
5. Thompson flow gauge
6. Channel for corroded iron
7. a. Lime adding equipment
   b. Caporiet adding equipment
8. Mixing channel
9. Sluice gates
10. Sedimentation basin
11. Spray aeration system
12. Sand filtration tanks
13. Pipes to reservoir
14. Reservoir
15. a. Pipes to public taps and bath-house
    b. Pipes to household taps
16. a. Hand pump
    b. Water for dissolving chemicals
    c. Pipes to sandwashing tank
17. Sand washing tank

THE PROCESS

Water enters the system from the River (1) via the intake and sluice gate (3), and is passed into the preliminary channel (4) where it is made calm. A dam (2) is sometimes needed to raise the water level in the river. The flow rate is then measured using a Thompson flow gauge (5) and the water is passed into the channel where corroded iron is situated (6). It is here that lime is added to the corroding iron from the lime supply (7) in order to aid the coagulation process. Mixing of the water with the coagulant then occurs in a mixing channel (8). It is here that the coagulant mixes with the colloid materials in the water and lumps are formed.

Water than passes through one of two sluice gates (9) into one of the two sedimentation basins (10) where the lumps are settled. In order that the water can have as much contact with the air as possible, and so that iron and manganese can be removed, it is passed into a spray aeration system (11) and dropped into a sand filtration tank (12). Two sedimentation tanks, spray aeration systems and sand filtration tanks are provided so that cleaning of one set will not stop the plant.

There are six layers in the filtration tanks. The top layer is coarse gravel which splits the water into finer drops to increase aeration. The next layer is an iron plate drilled with 10 mm holes to allow the water through. This plate which is coated with an anti-corrosive paint prevents the gravel from mixing with the sand beneath. Underneath the plate is a layer of finer grained sand and three layers of hard gravel which complete the filtration process.


The lime and Caporiet adding building

Finally, before being passed into a reservoir (13), the water is treated with Caporiet disinfectant to kill bacteria that may escape the sand filtration process (7b).

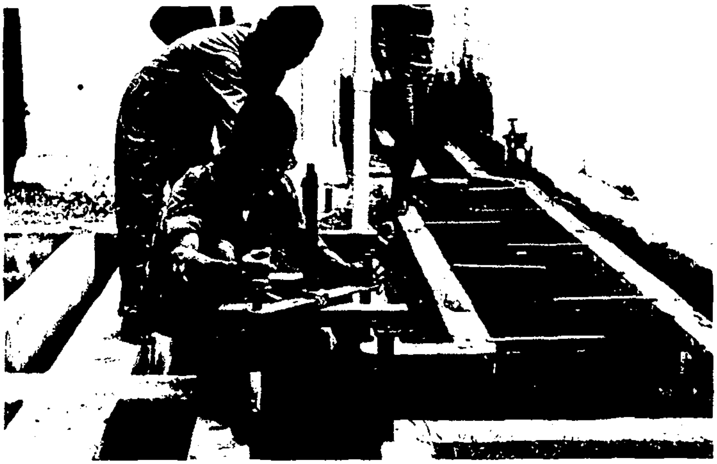
The Cikapayang plant has been designed to provide water through distribution pipes (15) to household and community taps or to public bath-houses. It is recommended that the plant be located so as to use gravity feed methods, thus avoiding the costly use of pumps. Two operators are required for the Cikapayang plant, and they can be unskilled local labourers. Minimal training is required for correct operation of the plant.

RESULTS

Tests so far carried out on water produced by the Cikapayang pilot plant in Bandung indicate that the system is able to meet both World Health Organisation and Indonesian Health Department specifications for clear water. However, it should be noted that the Cikapayang plant does not directly produce drinking water. Water for this purpose still needs to be boiled prior to use. Please note also that the Cikapayang plant cannot be used to purify heavily polluted water, such as that containing industrial effluents, or to purify heavily soiled or brackish water.

PLANT CAPACITY

The Cikapayang plant can produce 5 litres of water per second. Thus based on an average daily requirement per person of 80 to 100 litres, this plant can be used to supply about 5000 people. The Cikapayang plant is limited to the production of 5 l/s of clear water so that other rural uses of water can be maintained.



Opening the sluice gate between the mixing channel and the sedimentation basin.

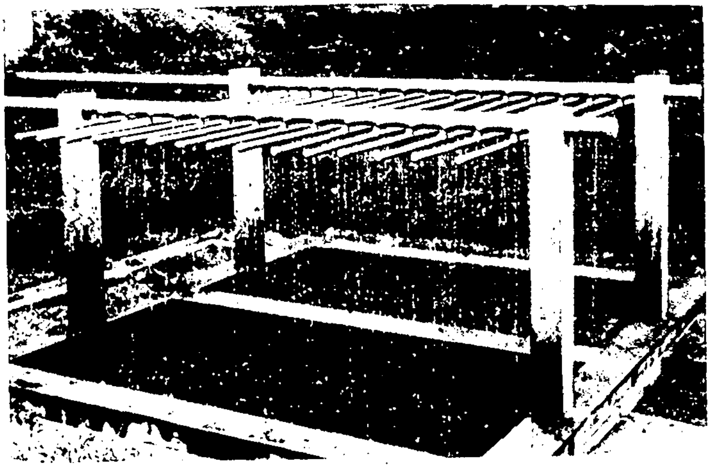
PLANT CAPITAL COSTS

Using October 1981 costs it is estimated that a Cikapayang plant would show capital costs as follows :

• Intake and mixing channel	Rp. 833.750,–
• Sedimentation tank	Rp. 3.208.700,–
• Aeration and filter tanks	Rp. 2.673.670,–
• Reservoir	Rp. 11.783.450,–
• Building for adding and storing chemicals and effluent lime treatment plant	Rp. 634.415,–
• Water tower for clear water used in process	Rp. 621.203,–
TOTAL	Rp. 19.755.188,–

These costs do not include the provision of distribution pipes or the purchase of land, because these costs will vary with topography. However, it should be noted that this plant requires about 1000 m^2 of land.

It is estimated that the monthly operating cost for the plant is Rp. 179.400,– and the cost per cubic metre of water is Rp. 33,50



Water passing through the aeration system into the sand filtration tank

COST COMPARISON WITH ANOTHER SYSTEM

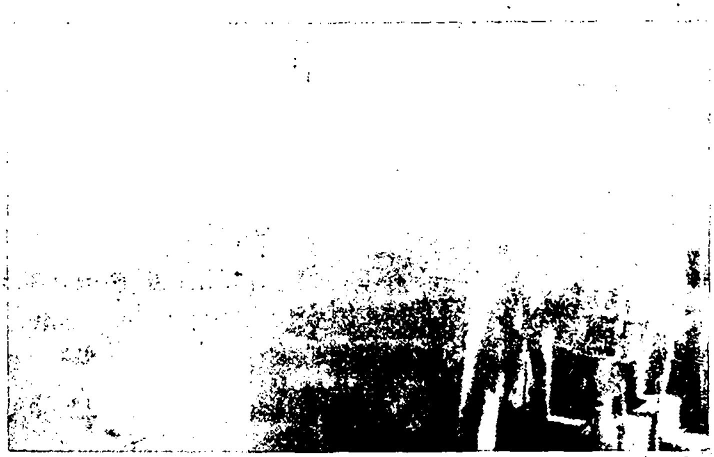
Below is given a brief cost comparison (1981) between the Cikapayang system, using iron and lime as coagulant, and a comparable system using aluminium sulphate as the coagulant.

	Iron/lime	Al. Sulphate
• Dose	25 mg/l	40 mg/l
• Capacity	5 l/s	5 l/s
• Daily dosing	10.8 kg	17.28 kg
• Chemical cost/kg	Rp. 20,–	Rp. 300,–
• Daily chemical cost	Rp. 216,–	Rp. 5.184,–
• Monthly chemical cost	Rp. 6,480,–	Rp. 155,520,–
• Yearly chemical cost	Rp. 77,760,–	Rp. 1,866,240,–
• Cost ratio	1	24

FUTURE PROGRAMME

Future research work with the Cikapayang plant will investigate the following :

- The optimum corrosion reaction of iron in different water samples.
- The use of different amounts of iron in the process and how this affects the process.
- Different types of water and their suitability for treatment.
- Alternatives to lime for areas where lime is hard to find
- The development of plan modifications for adjusting the system to local geographical conditions.



A "Corsen" structure to provide water for local inhabitants