How to Build a Low-cost Ferrocement Biogas Digester

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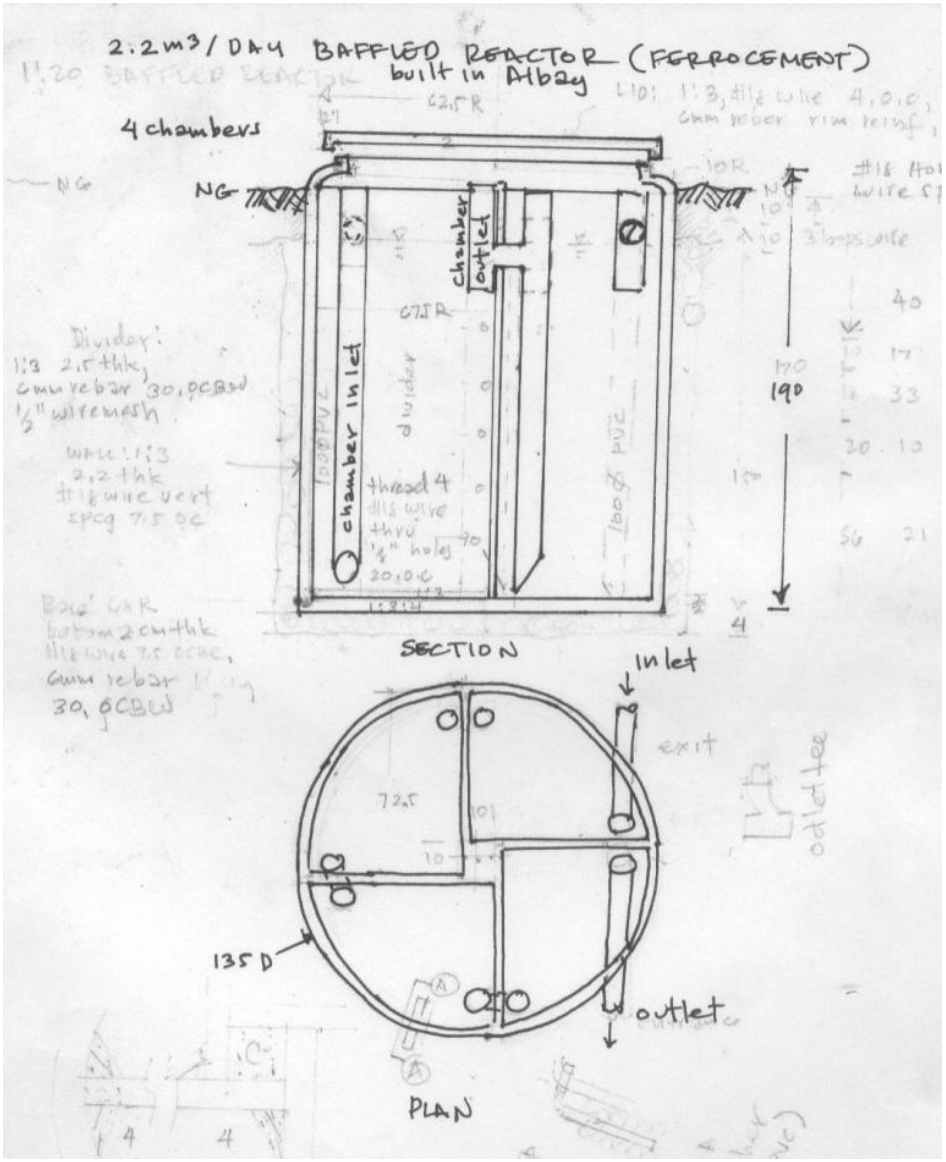
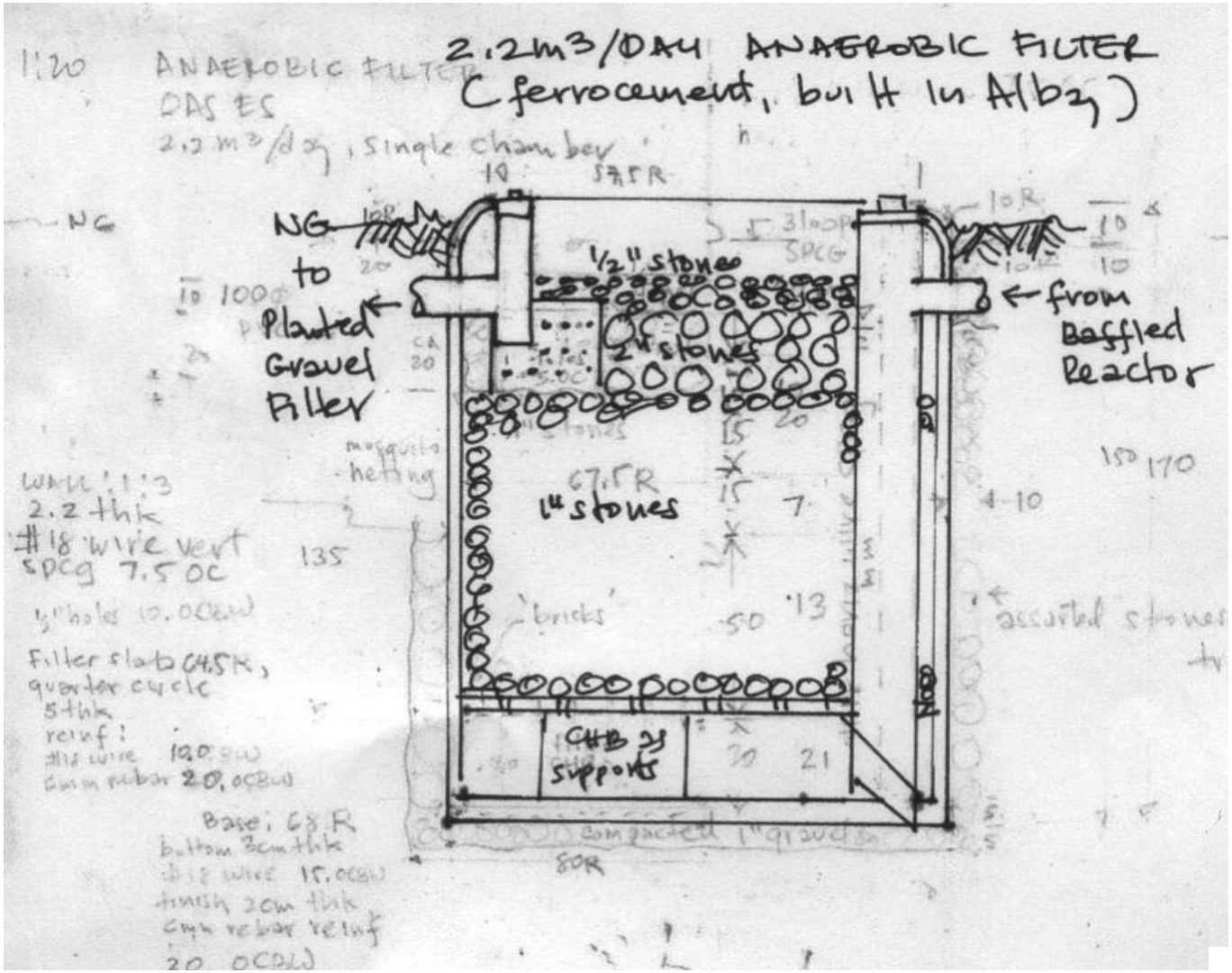
FERROCEMENT IN WASTEWATER FACILITY CONSTRUCTION

Ferrocement is a highly economical method of making septic tanks, baffled reactors (shown here).

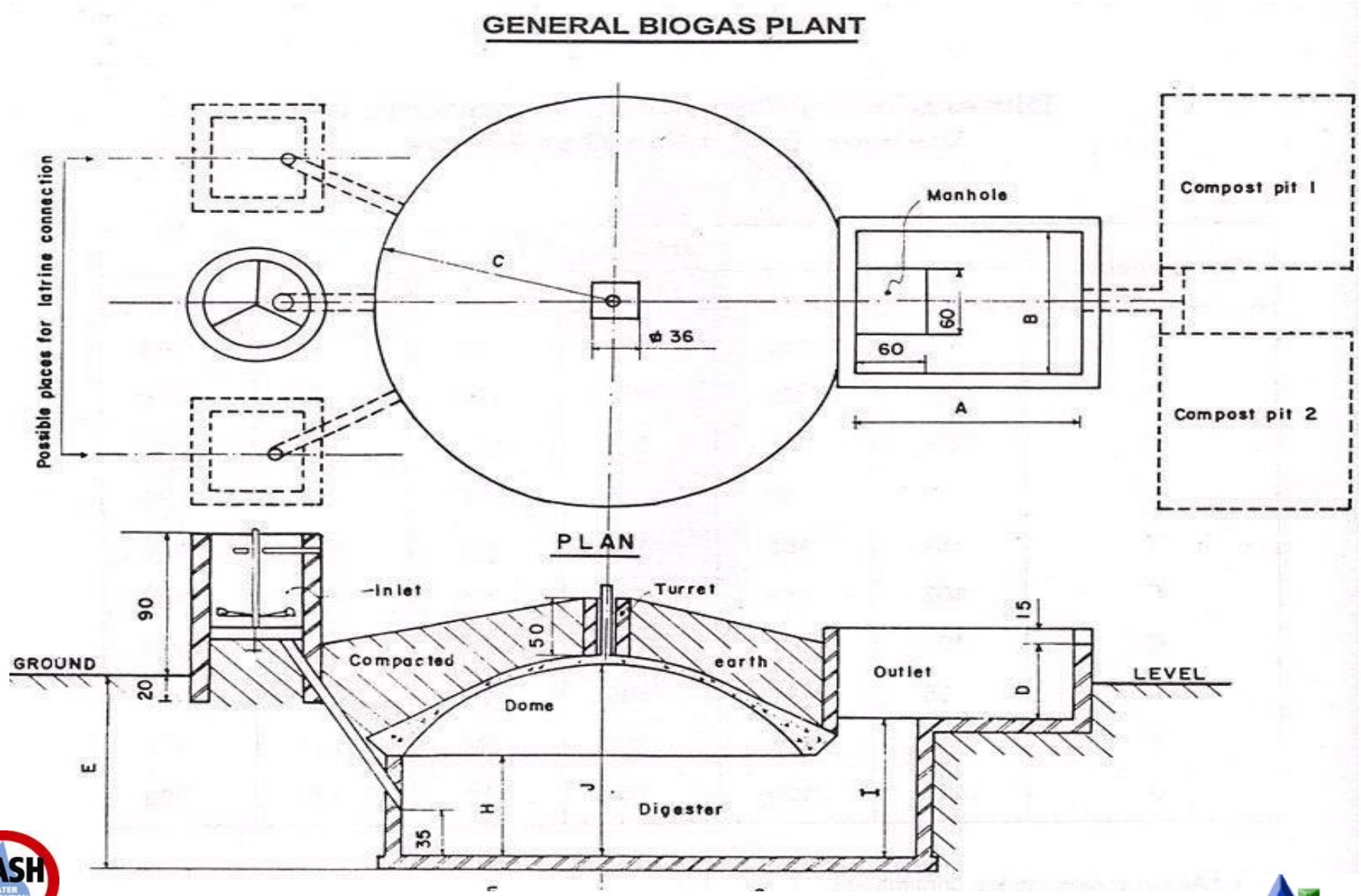


FERROCEMENT IN WASTEWATER FACILITY CONSTRUCTION

Anaerobic filter tanks



FERROCEMENT IN WASTEWATER FACILITY CONSTRUCTION



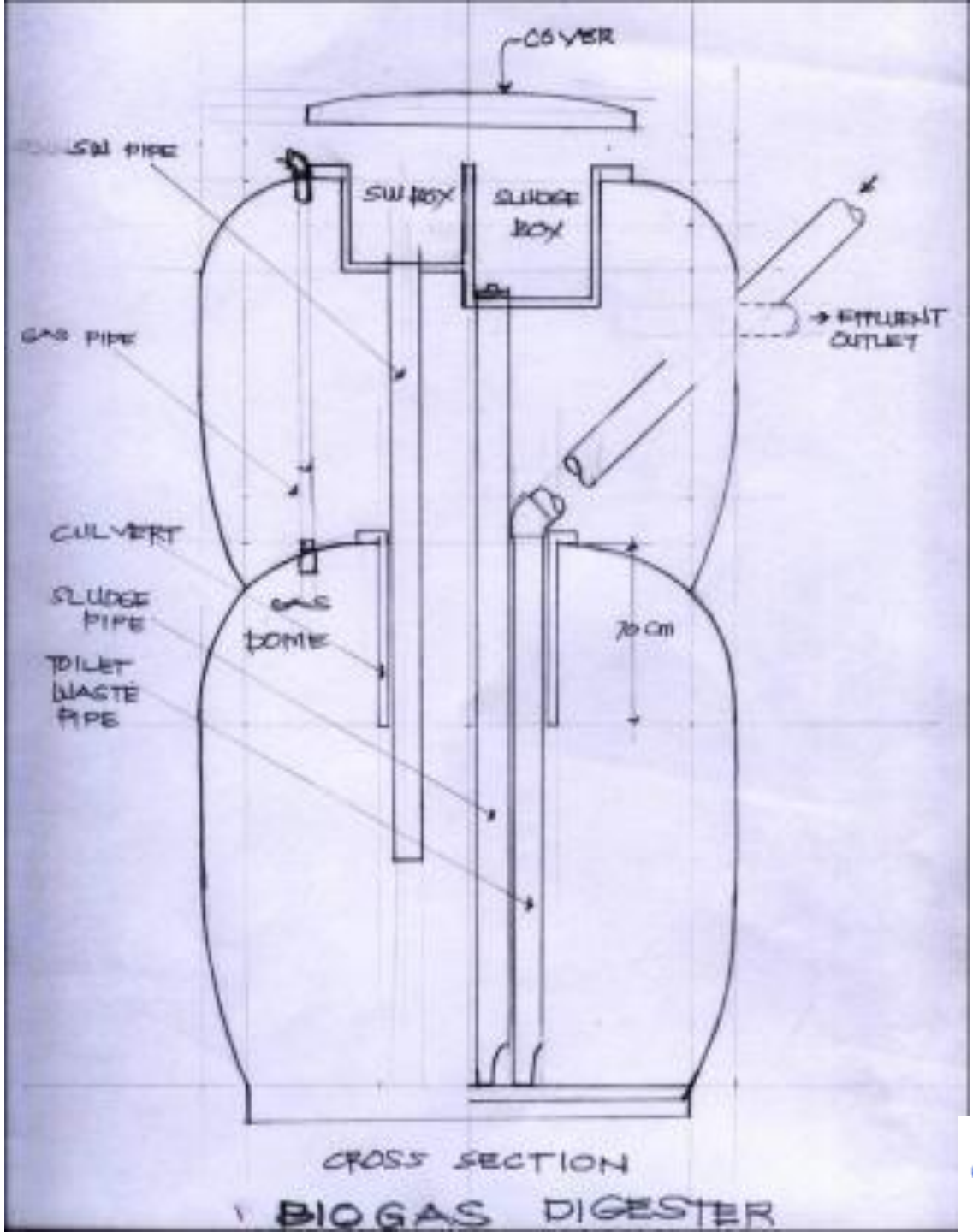
BIOGAS QUICK FACTS

1. Mainly methane plus some CO_2 (25%-50%). Methane- greenhouse gas several times more potent than CO_2 .
   One cubic meter = 0.5 litres diesel.
   One kg of compostable matter = theoretically 0.4m^3 biogas, but in practice only one-half to $\frac{3}{4}$ of this is attained.

How Biogas is produced in Digesters

1. Hydrolysis and acid formation in waste by acid-forming bacteria (*hardy, active*)
2. Production of methane from acids by methane bacteria (*sensitive*).

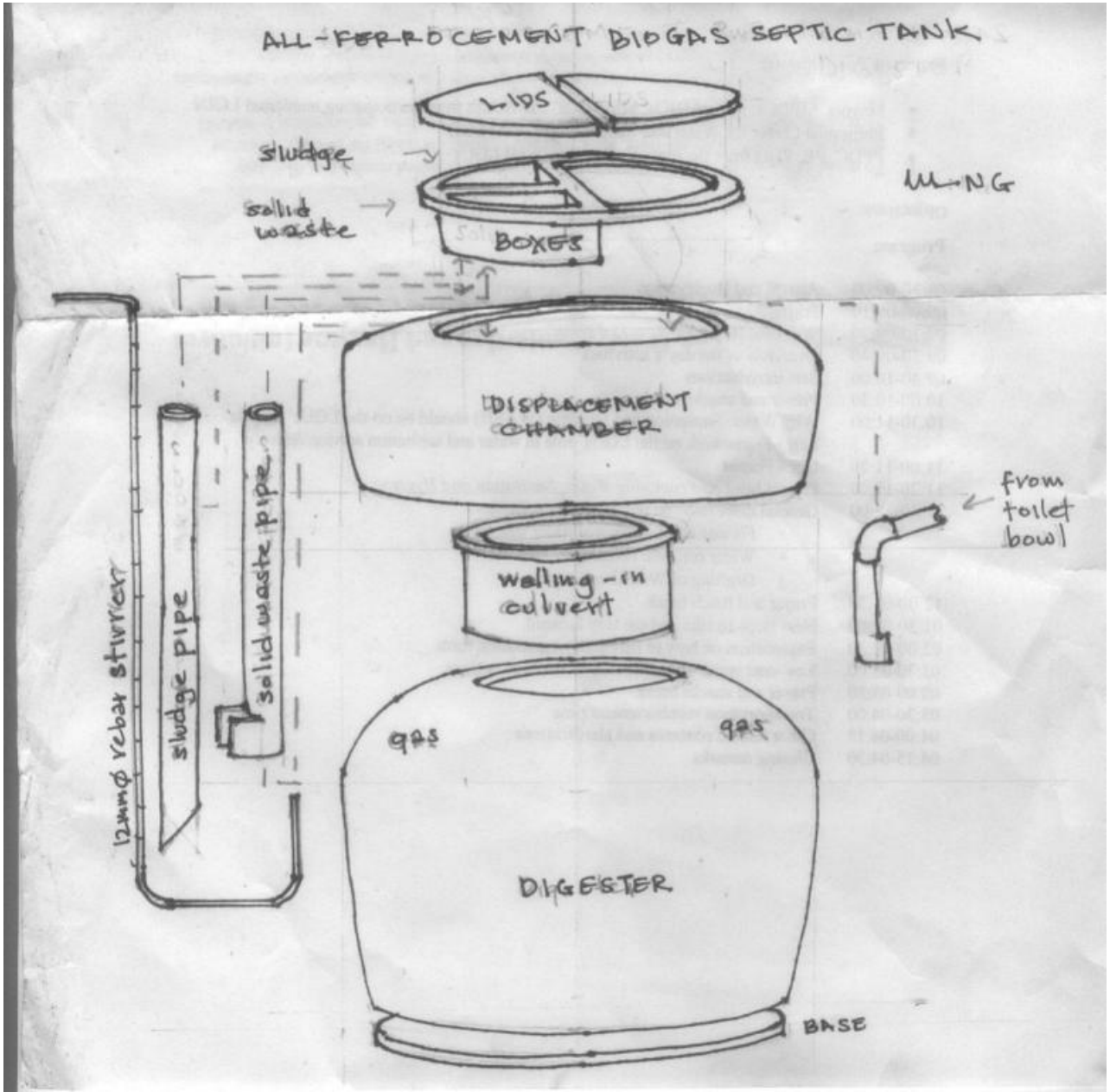
ALL-FERROCEMENT BIO-DIGESTER (PCWS MODEL)



ALL- FERROCEMENT BIO-DIGESTER (PCWS MODEL) FEATURES

1. Volume = 1.2m^3 displacement chamber, 3m^3 digester/gas collector chamber.
2. Co-axial displacement vessel and digester; saves space and facilitate piping and maintenance.
3. Cost: PhP12,000 in materials (50%) and labor. This does not include professional fee of engineer.
4. Good for at least 8 pigs.
5. up-sizeable design to at least 25m^3.
6. Stirrer for digestion efficiency.

BUILDING THE ALL-FERROCEMENT BIO-DIGESTER



Laying the Patterns

Bending the mold rebars

Welding the molds

Digester mold welding

Displacement chamber mold

Walling-in culvert mold welding

Finished molds

After cutting, the panels are clad in wire mesh.

Here the digester mold is re-assembled and wrapped in polyester curtain cloth.

Meanwhile, the hole for the biogas digester is dug.

Gravel base course for the base

Wire reinforcement for the base is laid, then cement is poured.

The digester mold wrapped in cloth and standing on the fresh-cast base

First mortar coating of the digester.

Vertical wires reinforcement for the digester

After the horizontal wiring is laid, a finishing mortar coat.

The digester is de-molded and finished inside.

The displacement chamber is made in the same way:
wrapping the assembled mold in polyester curtain cloth.

The displacement chamber mold is set atop the digester.

After a coating of mortar, the reinforcing wires are laid, the outside is finished and after a day, the chamber is de-molded.
The insides are then finished (not shown).

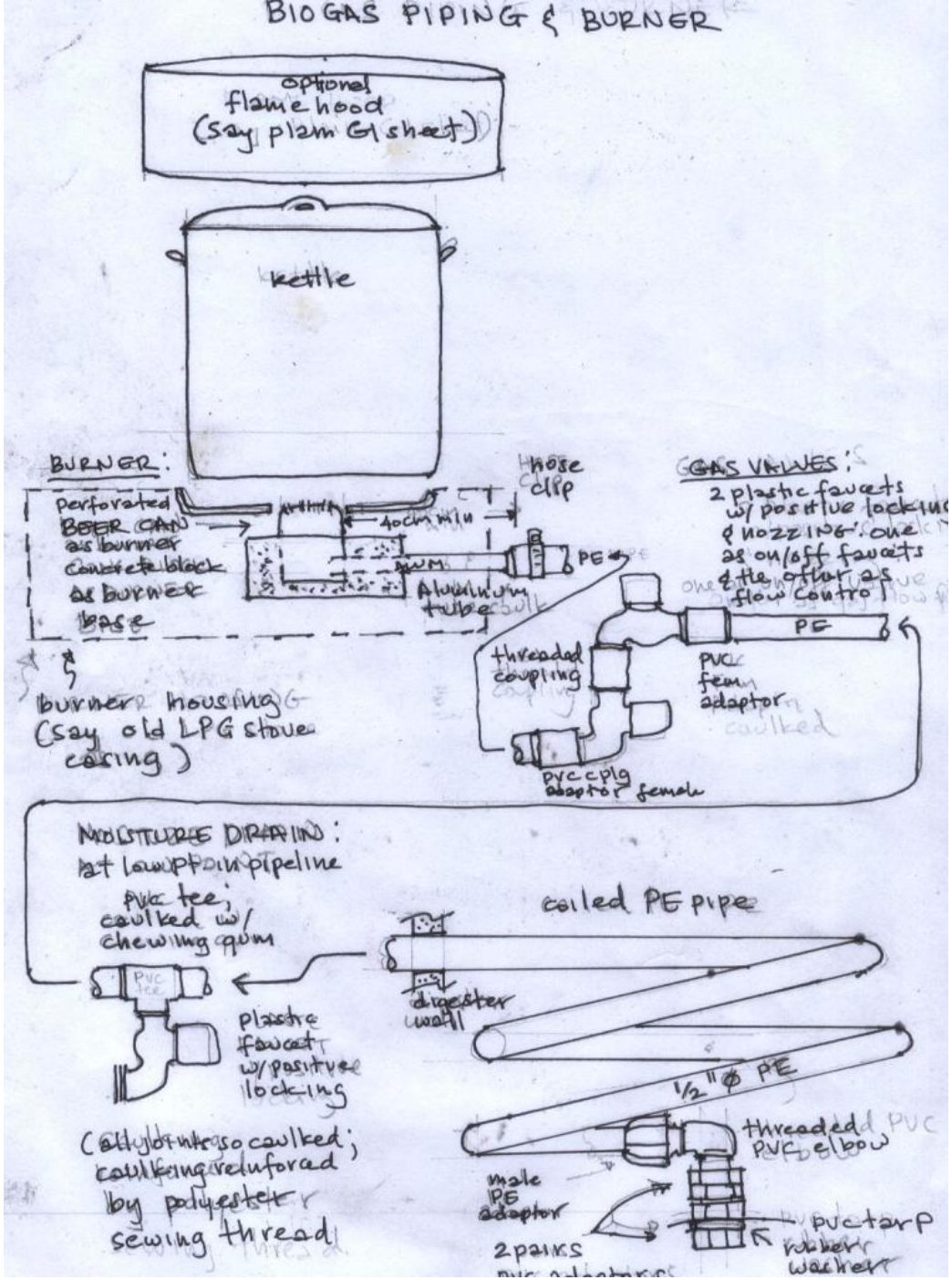
The sludge/solid waste box and the pipings are installed.

A lid is made for the box and manhole.

A biogas burner is made from some aluminum tubing and a beer can.

If the water table in a project site is low, the tanks can be prefabricated aboveground before setting into the excavation.

Finished but still needs leak testing, connecting to burner and operationalization.


BIOGAS PIPING & BURNER
optional
flame hood
(say plain GI sheet)
kettle
BURNER:
perforated
BEER CAN
as burner
concrete block
as burner
base
40cm min
Aluminum
tube
PE
hose
clip
GAS VALVES:
2 plastic faucets
w/ positive locking
& nozzling: one
as on/off faucets
& the other as
flow control
PE
threaded
coupling
PVC
fem
adaptor
PVC c plg
adaptor female
burner housing
(say old LPG stove
casing)
MOISTURE DRAINING:
at low point pipeline
PVC tee,
caulked w/
chewing gum
PVC
tee
plastic
faucet
w/ positive
locking
(all joints also caulked;
caulking reinforced
by polyester
sewing thread
coiled PE pipe
digester
wall
1/2" ø PE
threaded
PVC elbow
male
PE
adaptor
2 pairs
PVC tarp
rubber
washers

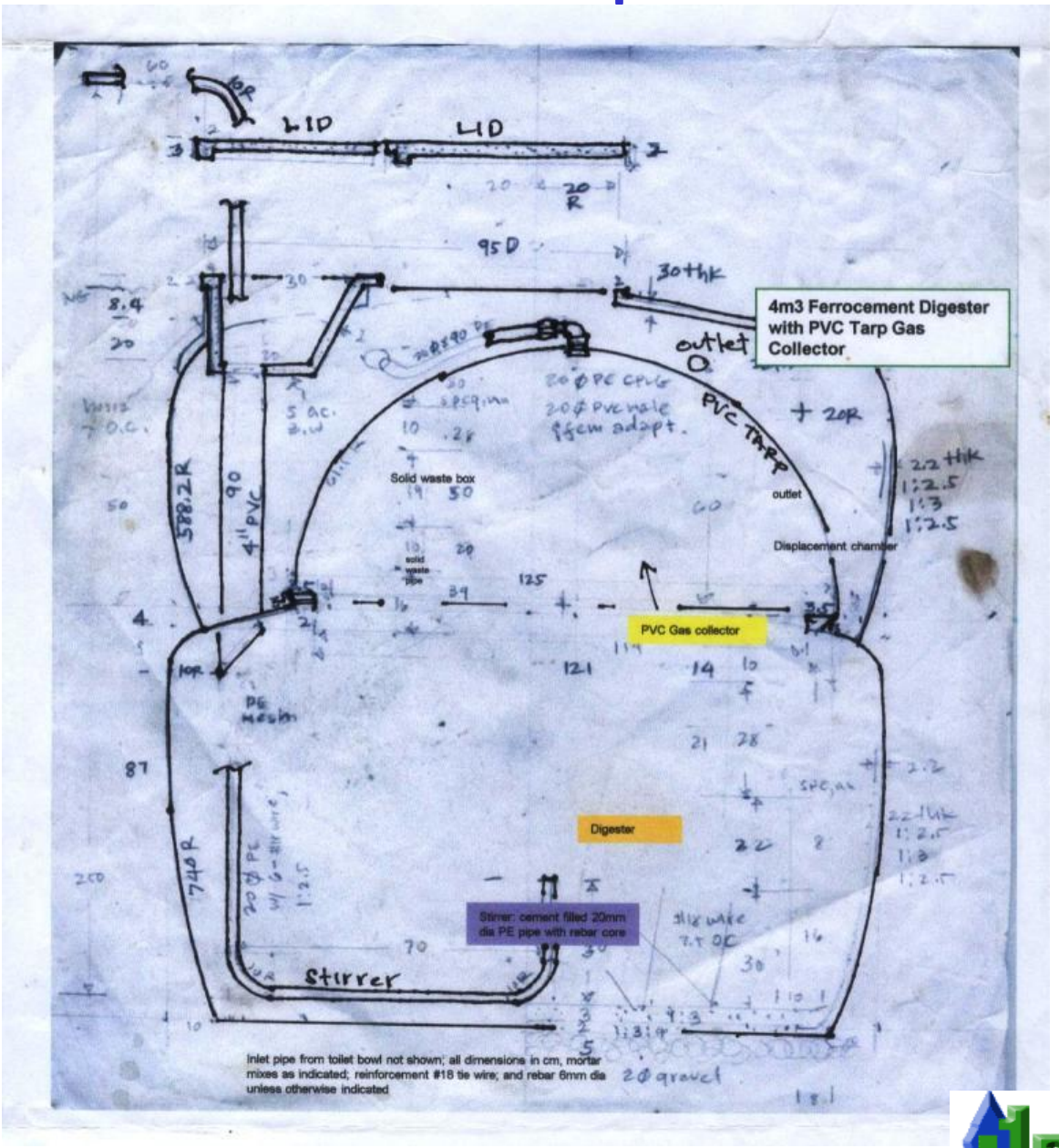
PCWS Bio-digester Version 2: PVC Tarp Gas Collector

Why tarp?

1. Cheaper (PhP5,000 per 1.8m^3 x 2m^3 digester)

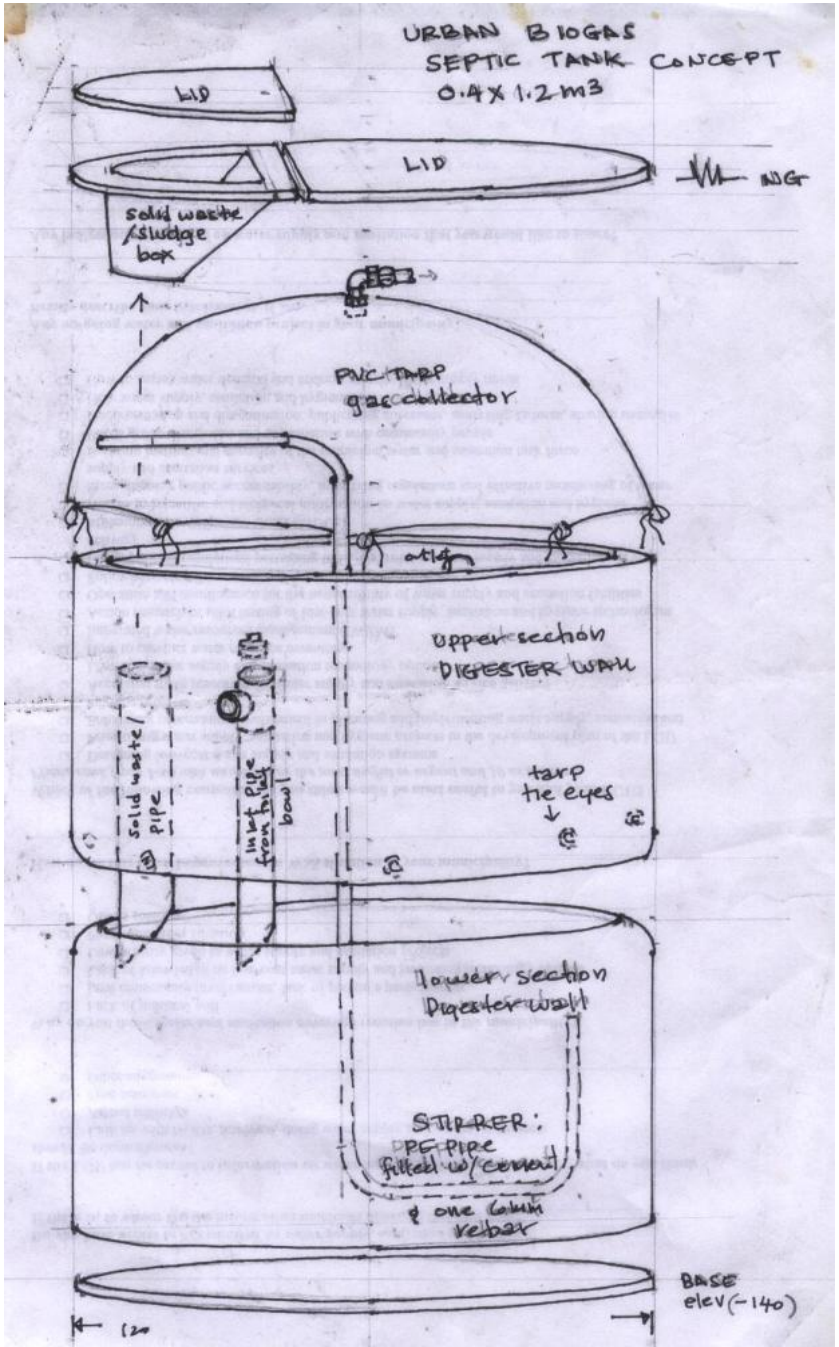
1. Does not require skilled mason for the ferrocement gas collector

2. Safer and easier to maintain.

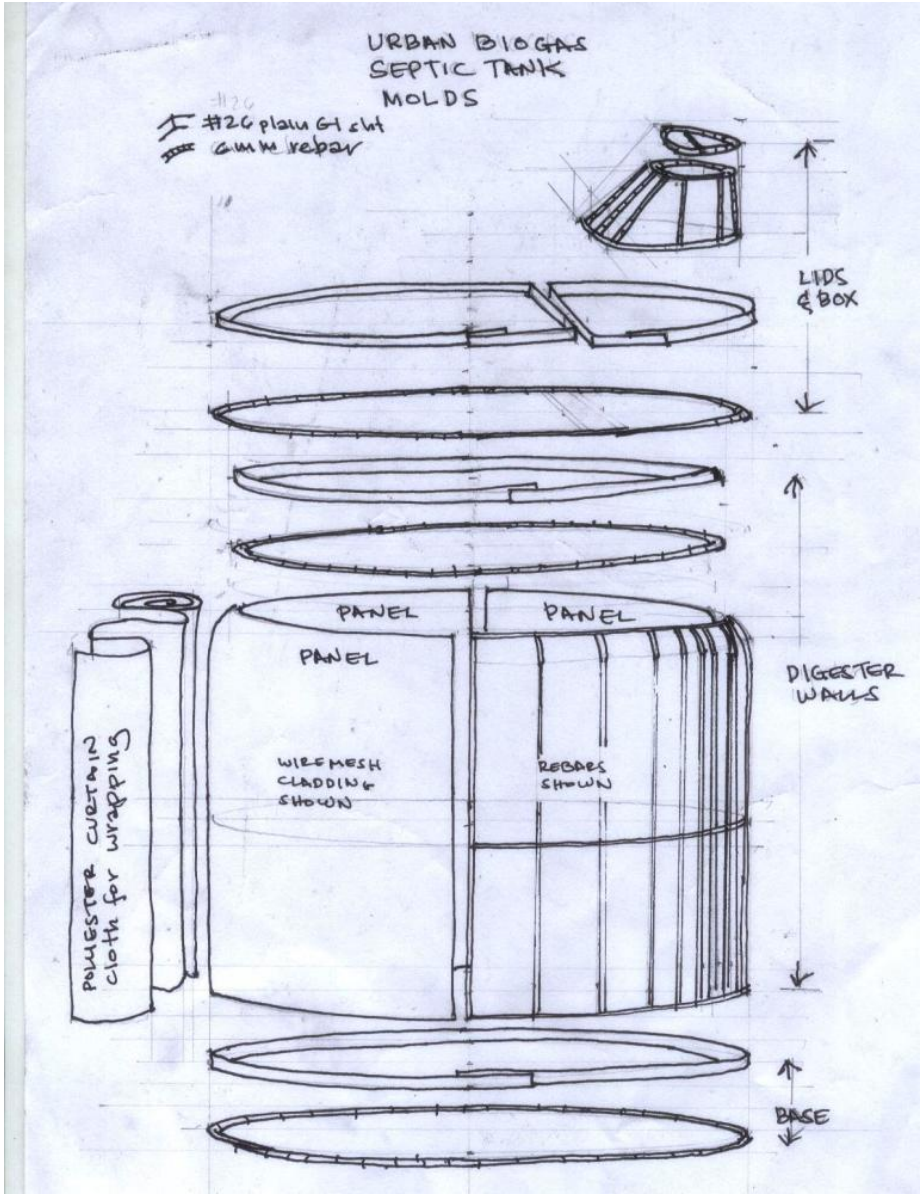


PCWS Biodigester Version 3 (for piloting): Urban Bio-Digester

Small diameter of 120cm will fit into more spaces in congested urban communities



Urban Digester Mold System



SOME FUTURE PROSPECTS FOR BIOGAS AND OTHER LOW-COST WASTEWATER TREATMENT

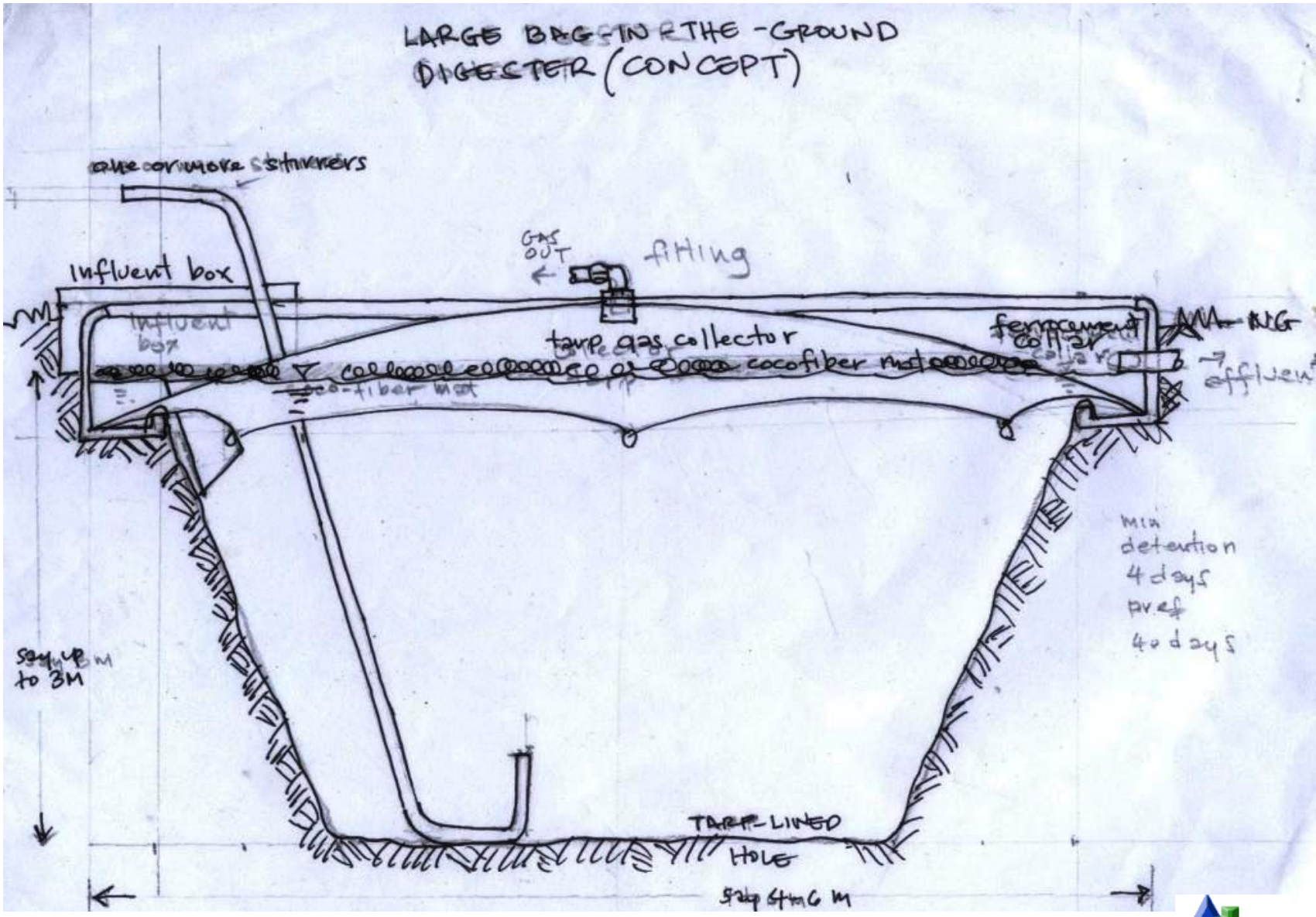
1. Possibility of replacing petroleum fuels if means to utilize cellulosic wastes are developed.

2. High-energy manure such as from pigs will probably be more valuable if a process for turning them to aquaculture feeds is found.

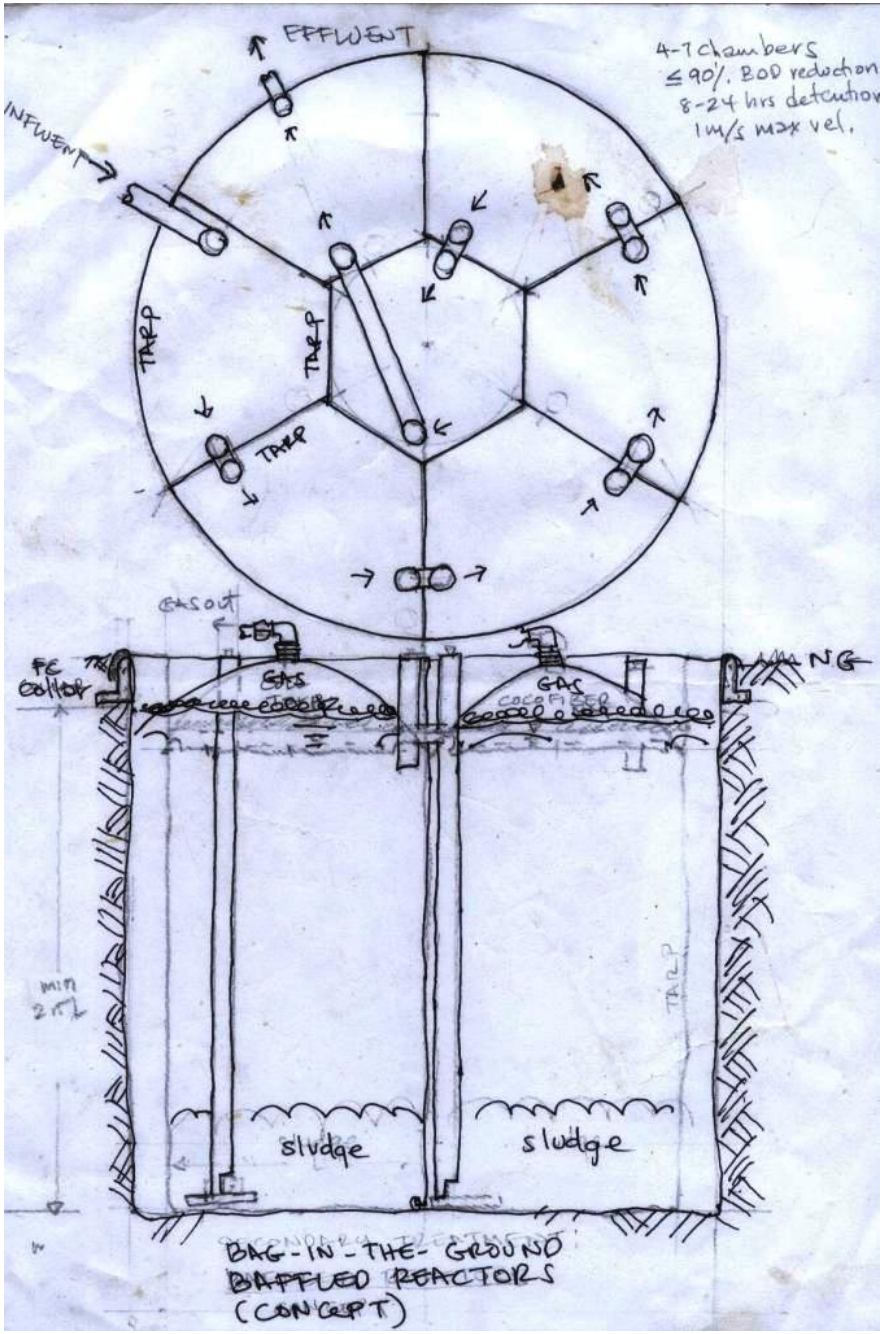
3. Try out /develop even cheaper wastewater treatment innovations to make them affordable:

4. Innovations for retrofitting existing wastewater installations for biogas harvesting and more efficient wastewater treatment.

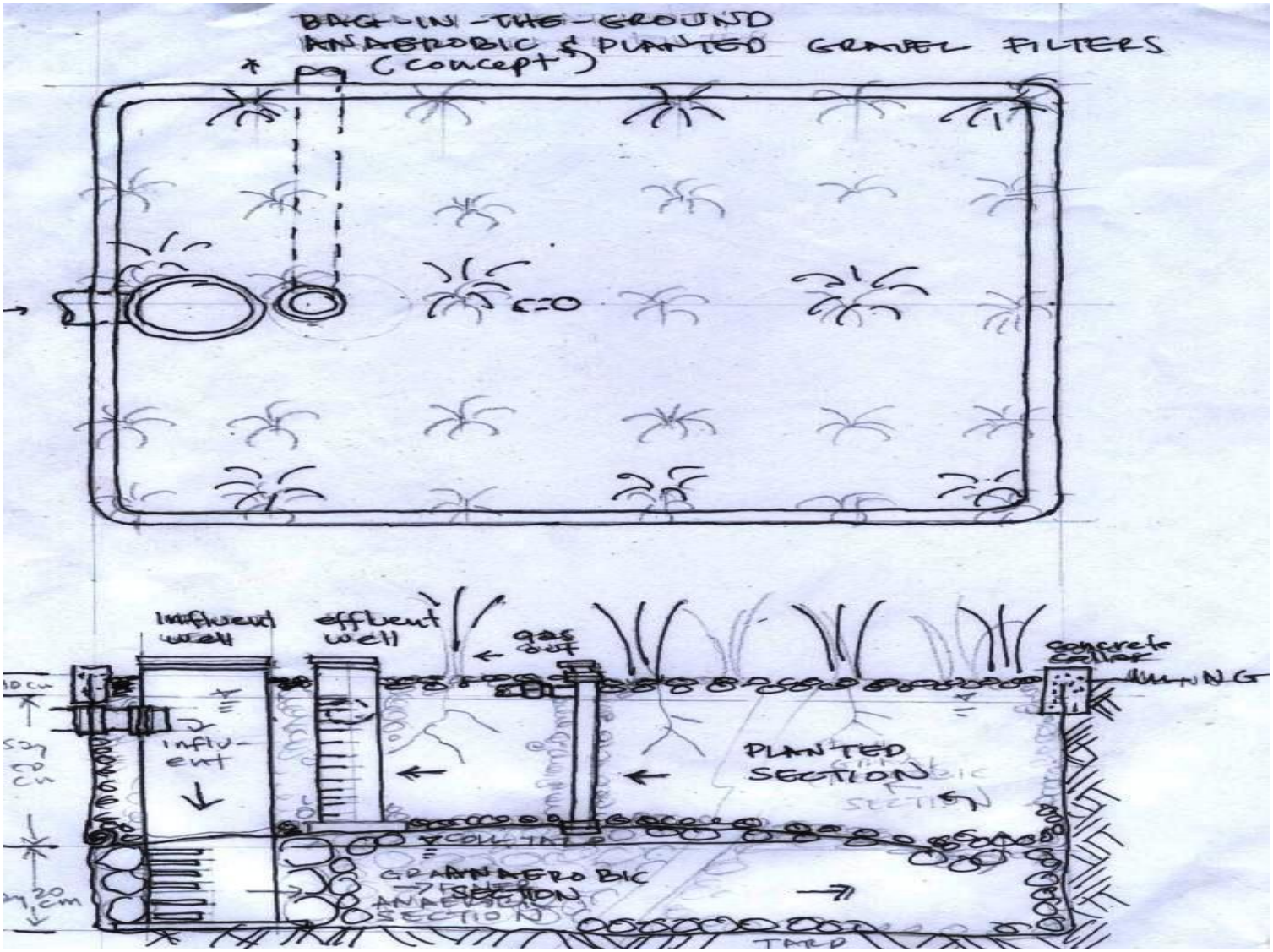
SUCH AS:


LARGE BAG-IN-THE-GROUND
DIGESTER (CONCEPT)
influent box
GAS OUT
fitting
tarp gas collector
cocofiber mat
effluent
min detention 4 days pref 4 days
TARP-LINED HOLE

SUCH AS:


EFFLUENT
INFLUENT
4-7 chambers
≤90% BOD reduction
8-24 hrs detention
1 m/s max vel.
BAFFLE
BAFFLE
BAFFLE
GAS OUT
GAS
GAS
sludge
sludge
BAG-IN-THE-GROUND
BAFFLED REACTORS
(CONCEPT)

SUCH AS:


BAG-IN-THE-GROUND
ANAEROBIC & PLANTED GRAVEL FILTERS
(Concept)
influent well
effluent well
gas out
concrete collar
PLANTED SECTION
influ-
ent
ANAEROBIC SECTION

5. Prospect of Developing Bacterial Fuel Cells (Electricity Direct from Biogas or Digesting Microbes)

For more information please contact

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and

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