Biogas Cooker
Cooking with methane gas

Www.perma-fun-K.com
perma_fun_Kinfo@yahoo.com

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Why using biogas?

- Free source of renewable energy (heat, cook, fertilizers..)
- Captures & uses methane gas & CO2 that normally go into the atmosphere.
- Collecting biogas from anaerobic digestion of swine manure can benefit the environment by reducing methane emissions (has potential value for equivalent carbon credits or greenhouse gas (GHG) credits), and by providing energy, as biogas is about 60 to 70 percent methane[e].

Anaerobic digestion

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the **absence of oxygen**. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels.

Anaerobic digestion is widely used as a **source of renewable energy**. The process produces a **biogas, consisting of methane (60/70% CH4), carbon dioxide (30/40% co2)** and traces of other ‘contaminant’ gases. This biogas can be used directly as fuel, in combined heat and power gas engines or upgraded to natural gas-quality biomethane. The nutrient-rich digestate also produced can be used as fertilizer.

The digestion..

The digestion process begins with bacterial hydrolysis of the input materials. **Carbohidrates** (unsoluble) are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the **sugars and amino acids into carbon dioxide**, hydrogen, ammonia, and organic acids. These bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide

1- **BIODEGRADABLE MATTER (HIDROLISIS + ANAEROBIC SYSTEM)**

2- **CARBOHIDRATES (UNSOLUBLE PARTS) = broken down= available for Bacteria**

3- Acidogenic Bacteria converts CARBOHIDRATES into:

Sugars
Amino acids
CO2
Hydrogen
Organic Acids
Amonia

4- Methanogens convert into:

→ **METHANE 60/70%**
CO2 30/40$

BIOGAS= 60/70% METHANE + 30/40% CO_2

HOW TO PRODUCE MORE BIOGAS & REDUCE HRT?

- PRETREATED SUBSTRATED (maceration increments fiber surface & methane production) + longer times (30m increments 64% methane production)
- ADDITIVES (iron salts, calcium & magnesium..)
- MIXING
- MESOFOLIC TEMPERATURES 30/40C

ANAEROBIC DIGESTION

- VOLATIL ORGANIC SOLIDS (VS)

PRODUCES BIOGAS

METHANE/CH4 60/70%

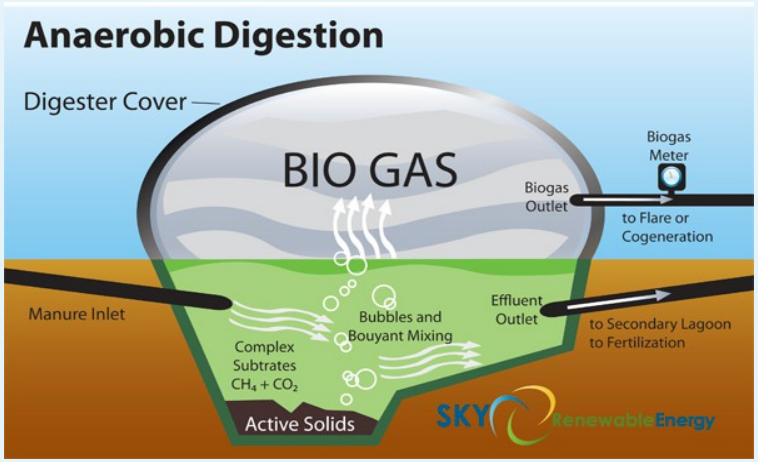
CO2 30/40%

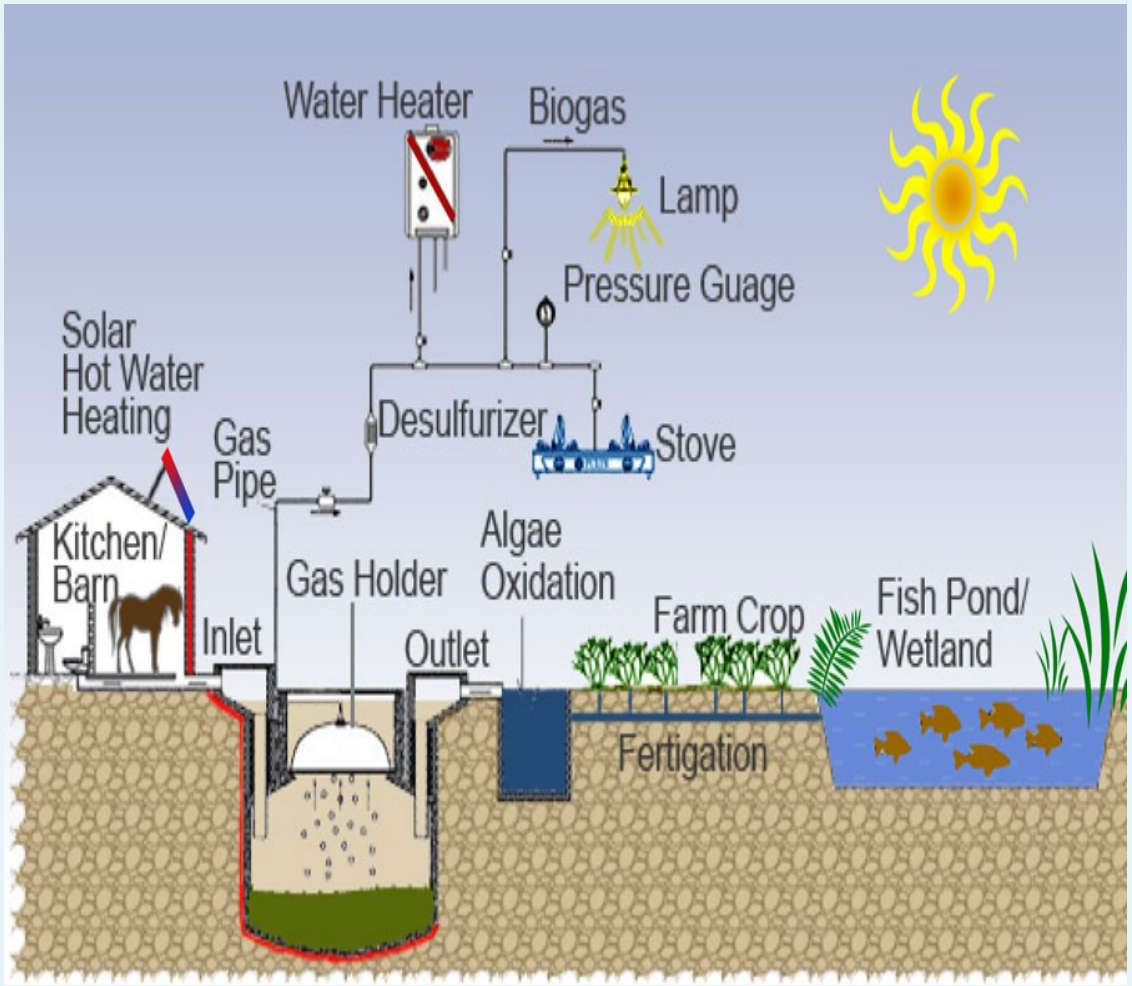
HYDRAULIC RETENTION TIME (HRT)

Factors that affect methane productivity

- Species, breed, diet, maturation of animal
- Type of bacteria selected (temperature, ph, C/N ratio)
- Pretreatment processes
- Mixing techniques
- Separation techniques

Small scale digestors




Water Heater
Biogas
Lamp
Pressure Guage
Solar
Hot Water
Heating
Gas
Pipe
Desulfurizer
Stove
Kitchen/
Barn
Algae
Oxidation
Gas Holder
Farm Crop
Fish Pond/
Wetland
Inlet
Outlet
Fertigation

Bag digestors

BIOGAS USE

- Digester Biogas – usually 60-80% methane, heating value of 600-800 Btu/ft^3
- Most equipment that uses natural gas, propane, butane can be fueled by biogas
- Opportunities for equipment fueled on coal and fuel oil as well.

- **Electricity** – Internal combustion engines, microturbines, fuel cells – For on-farm use and/or sale to grid
- Co-generation (combined heat and power) – Capture heat from engine for electricity generation to warm digester
  – Could provide heat, hot water or steam for farm or neighboring operations when heat available exceeds the needs of the digester
- **Boilers and Heaters**
- **Chilling/Refrigeration**

Effluent Storage

- Stabilized organic solution
- Good value as a fertilizer
- Storage needed as nutrients cannot be land applied year round
  - May be applied through a center pivot

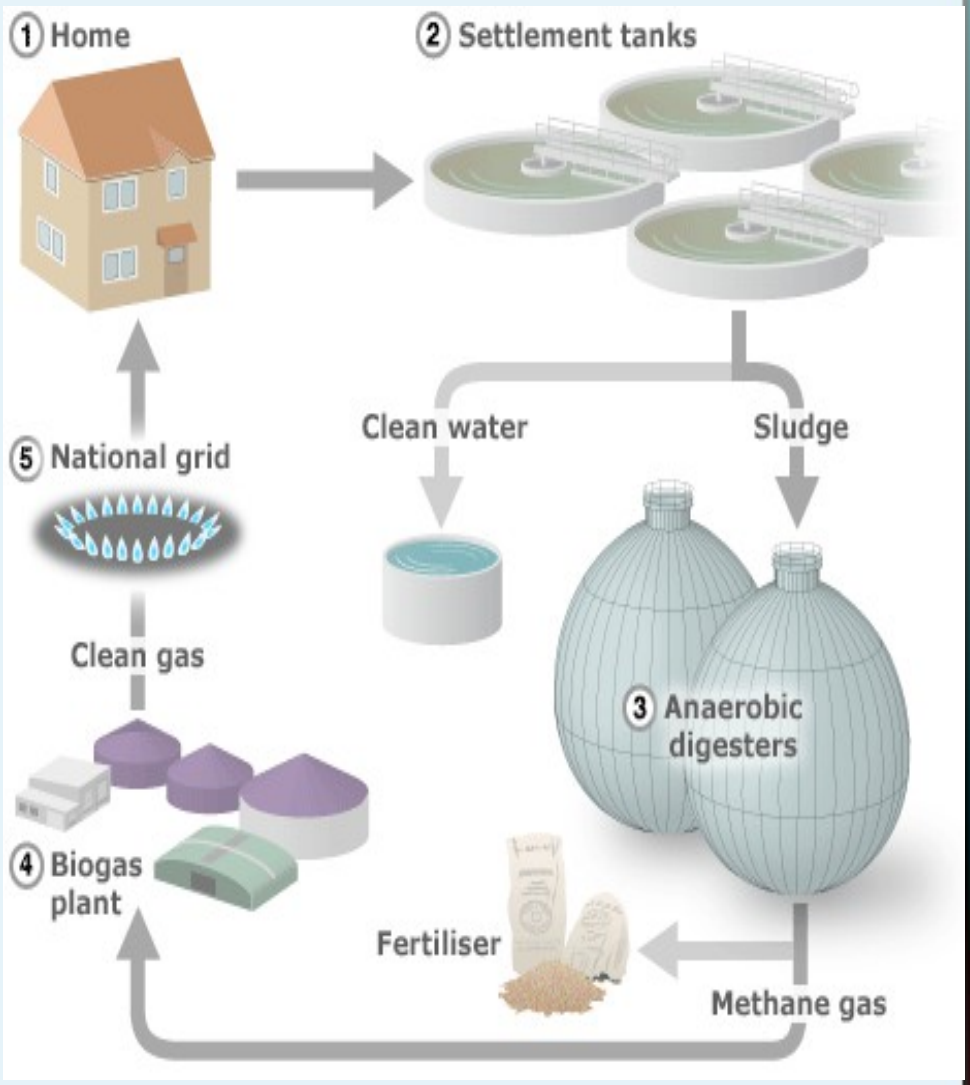
Benefits of Biogas Projects

- On and Off-Site Farm Energy
- Reduced Odors
- High Quality Fertilizer
- Reduced Surface and Groundwater Contamination
- Pathogen Reduction
- Fiber Recovery and Use

Preliminary Screening for Project Opportunities

- Is your confined livestock facility ‘large”?
- In manure production and collection stable year round?
- Is your manure management compatible with biogas technology?
- Is there a use for the energy recovered?
- Will you be able to manage the system effectively?

Large scale digestors



METHANE RATIOS

Loading rate, pounds volatile solids per cubic feet digester volume per
Swine: 0.14
Dairy: 0.37
Poultry: 0.12
Beef: 0.37

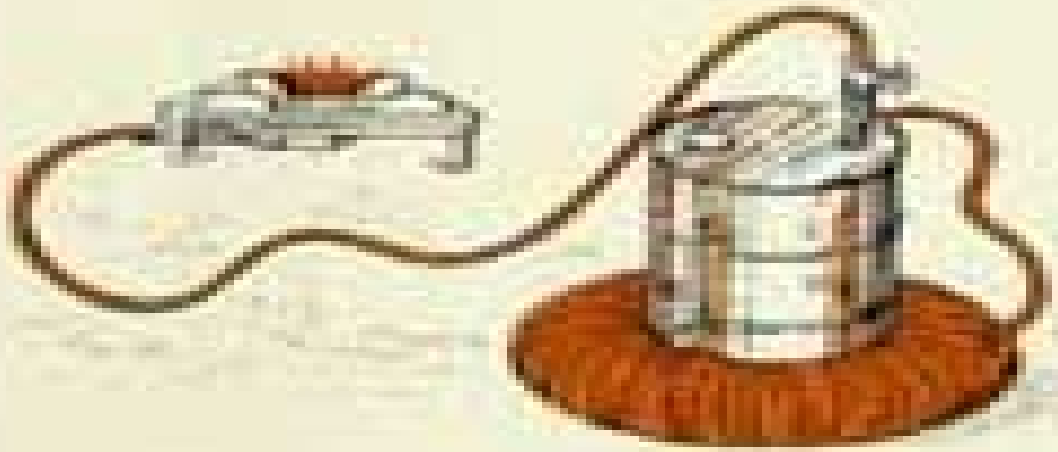
Detention time, days
Swine: 12.5
Dairy: 17.5
Poultry: 10
Beef: 12.5

Digester volume, cubic feet per animal
Swine: 5
Dairy: 26
Poultry: 0.37
Beef: 13.5

Digester volume for a typical livestock operation cubic feet per gallon
Swine (500 head): 2,500/20,000
Dairy (75 head): 1,950/15,000
Poultry (15,000 birds): 5,550/42,000
Beef (300 head): 4,050/30,40

32

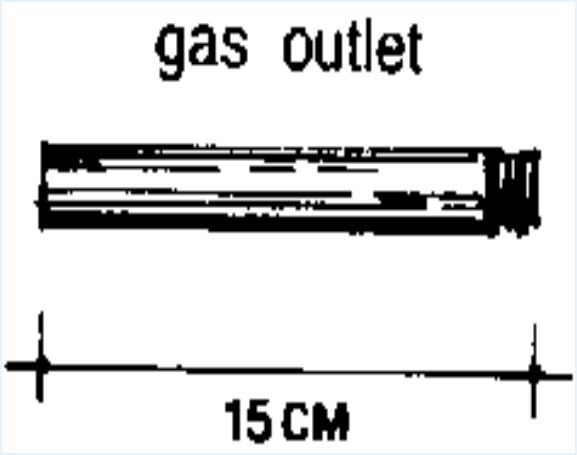
biogas 2

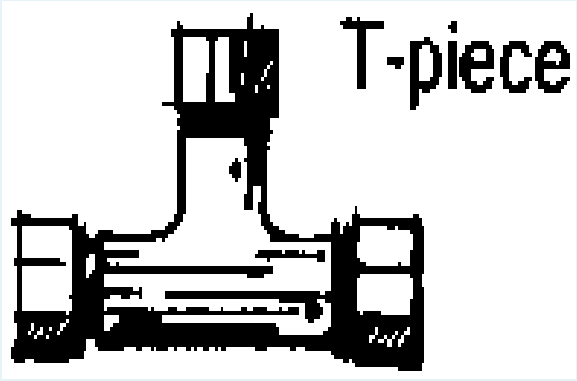


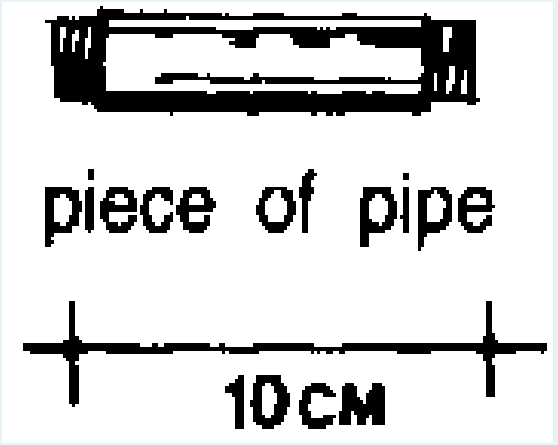
Materials

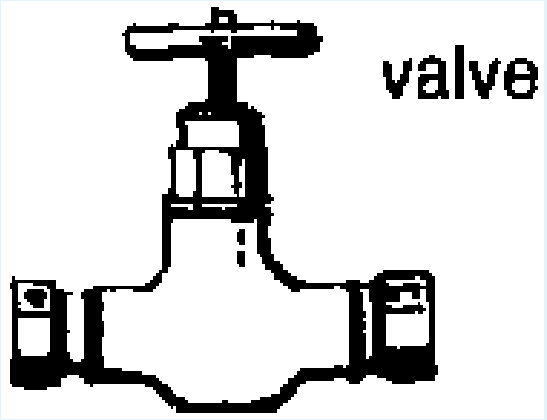
- Metal/plastic drum 50gal with threaded holes
- Gas outlet 15cm
- T piece (for each inner tube)
- Piece of pipe that fits the T piece 15cm
- Valve that fits the pipe
- 32 feet rubber or gas lines
- One or more inner tubes to collect the gas.

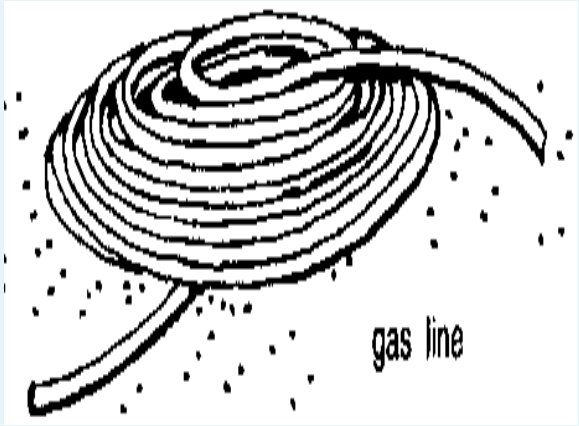
MATERIALS

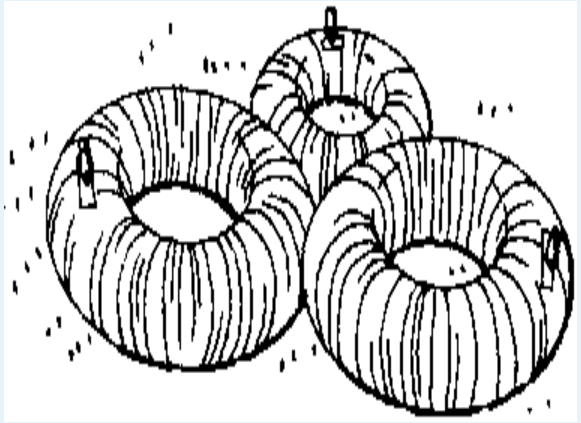




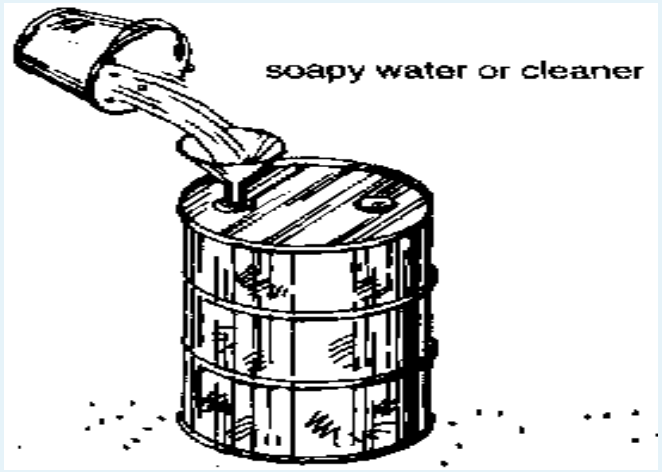


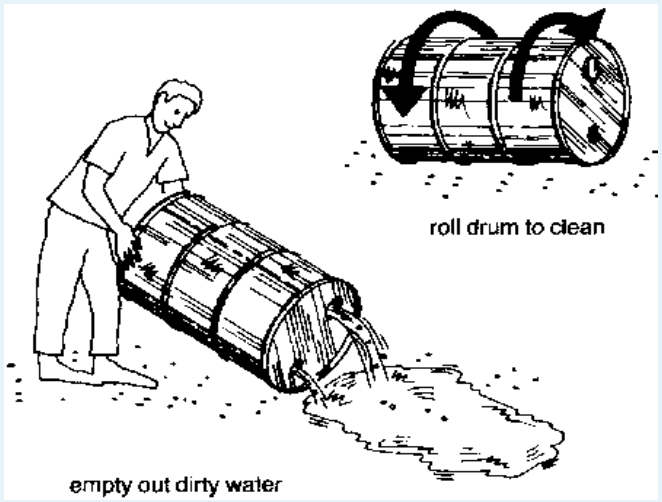


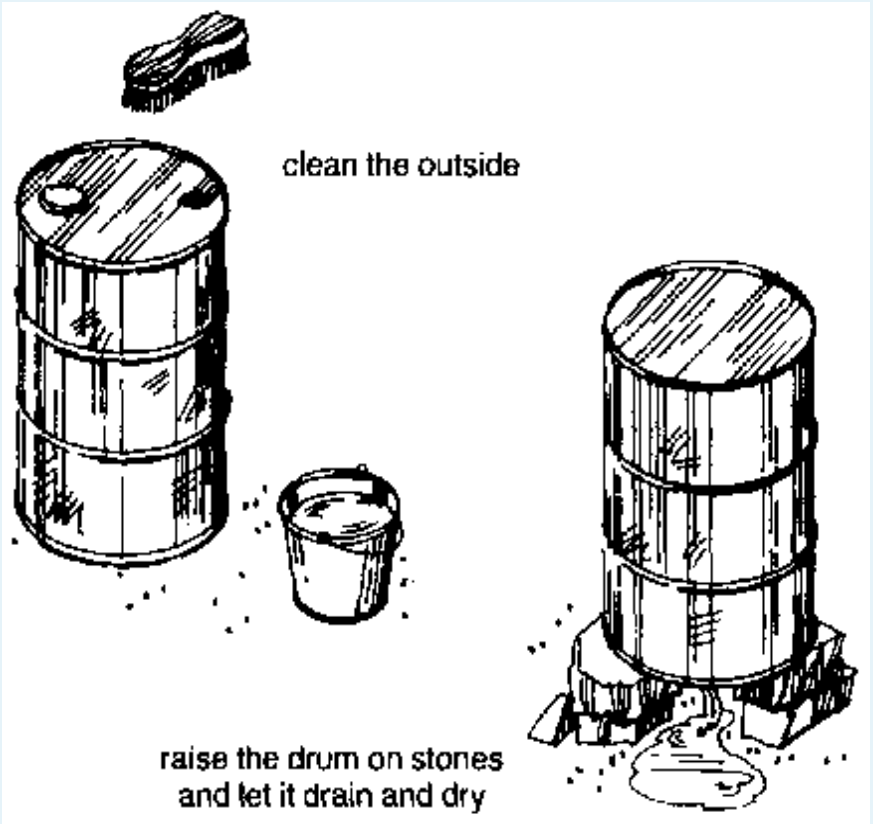




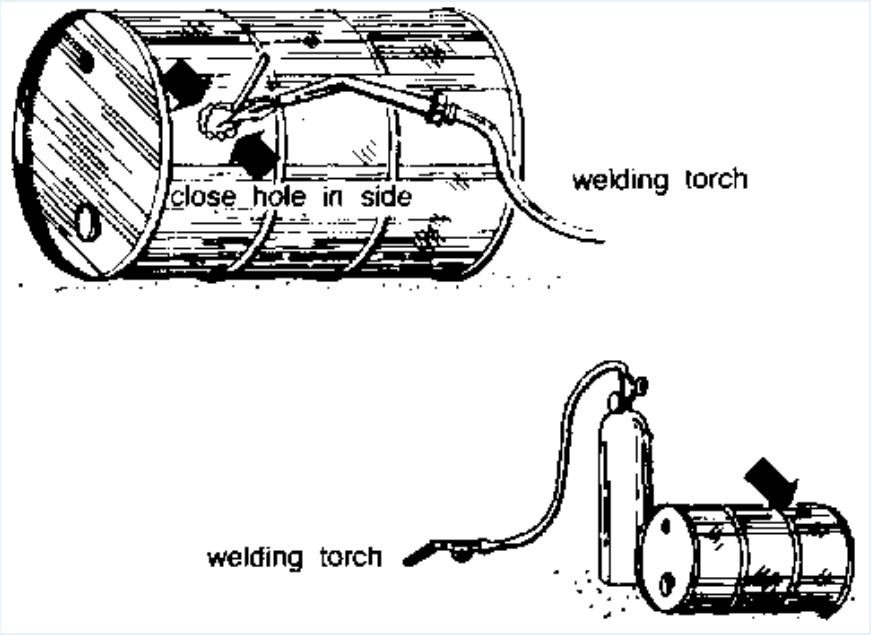
CLEANING THE DRUM

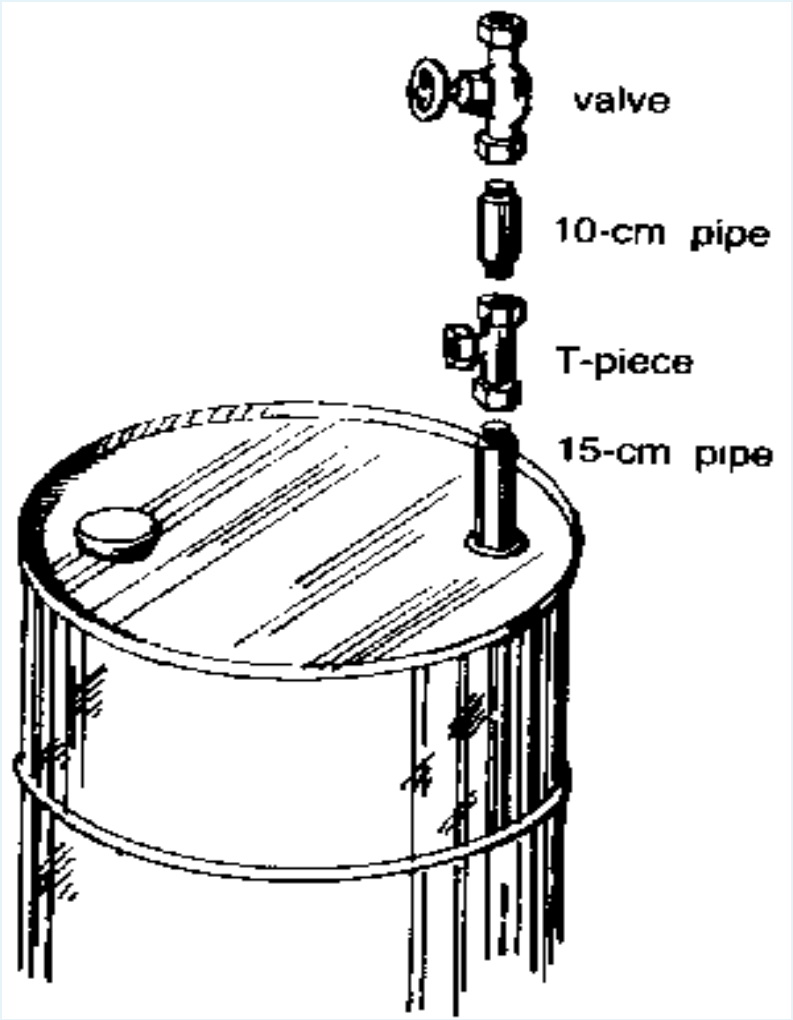




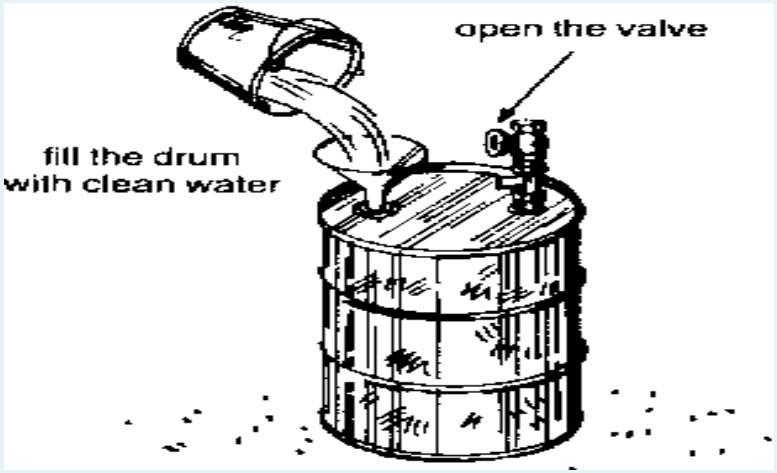


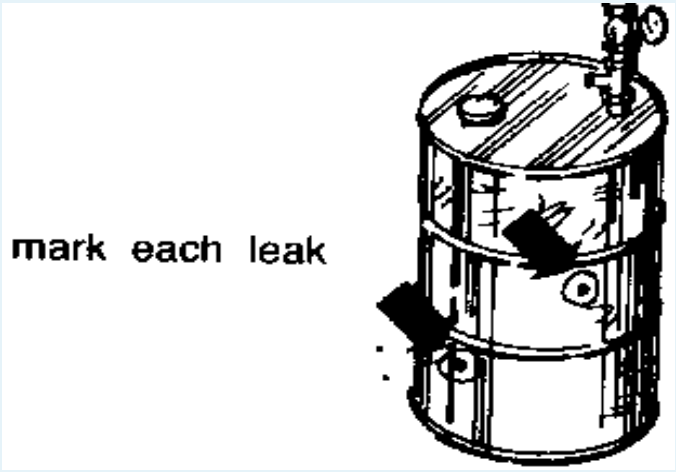
PREPARING THE DRUM

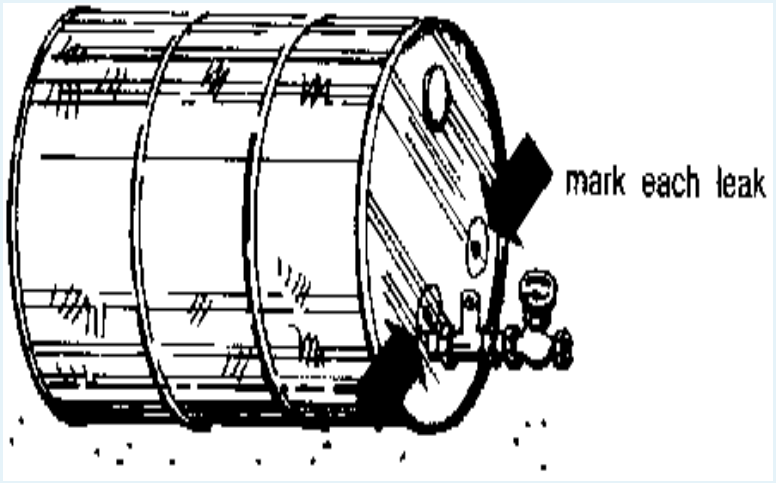


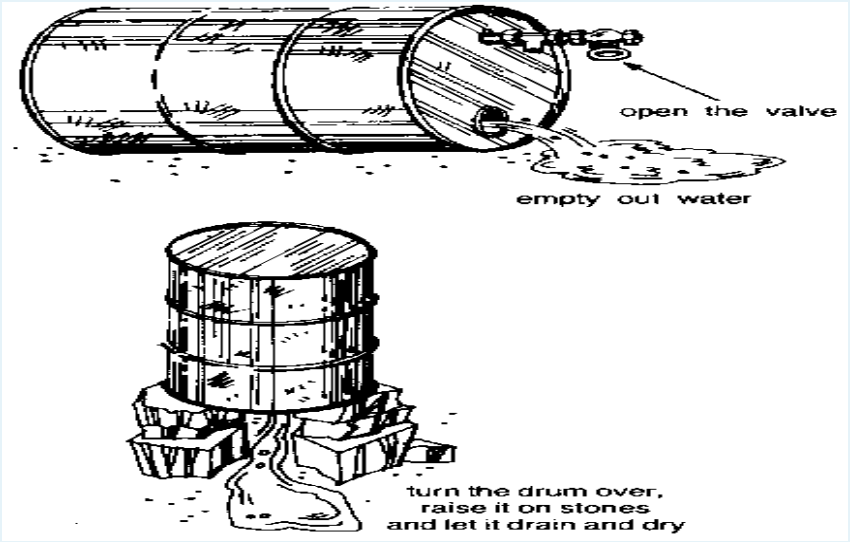


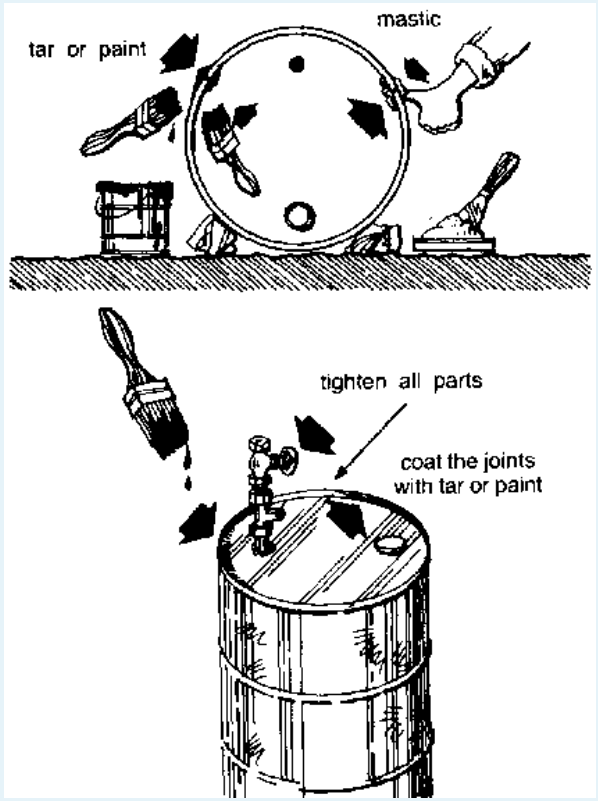
TESTING FOR LEAKS

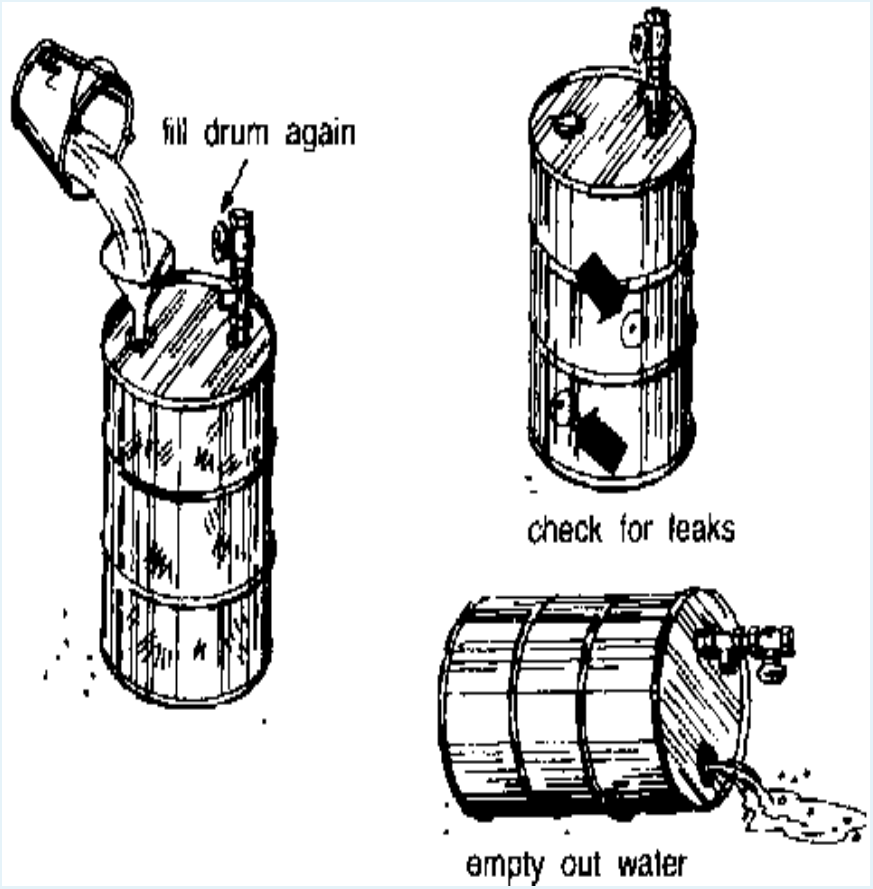




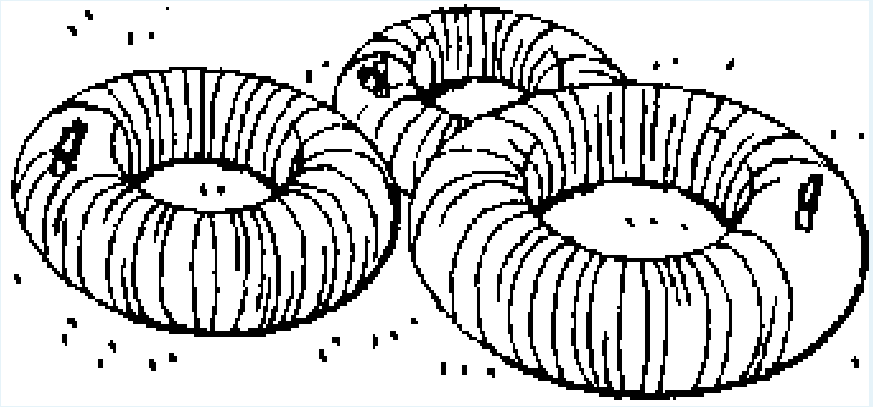


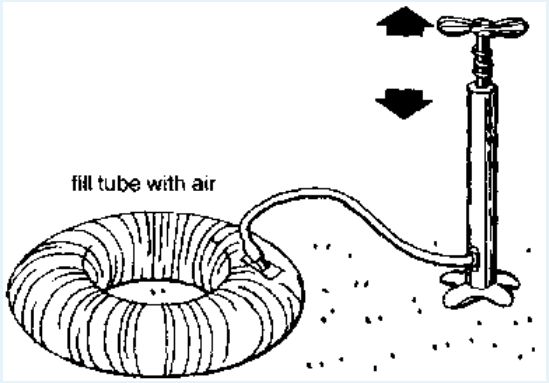


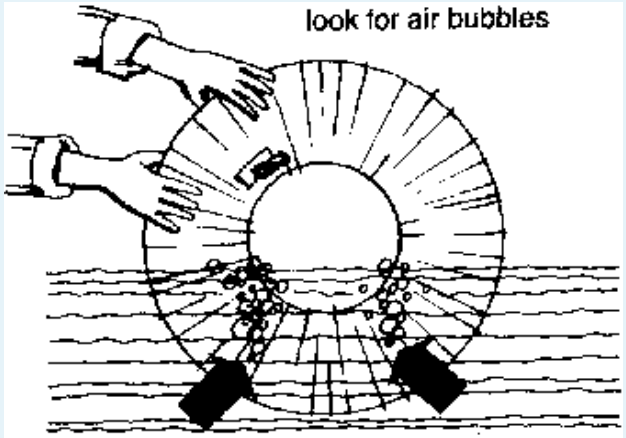

mastic
tar or paint
tighten all parts
coat the joints
with tar or paint

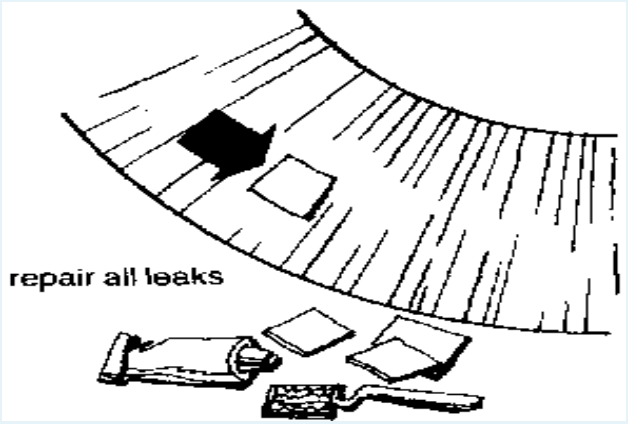

fill drum again
check for leaks
empty out water

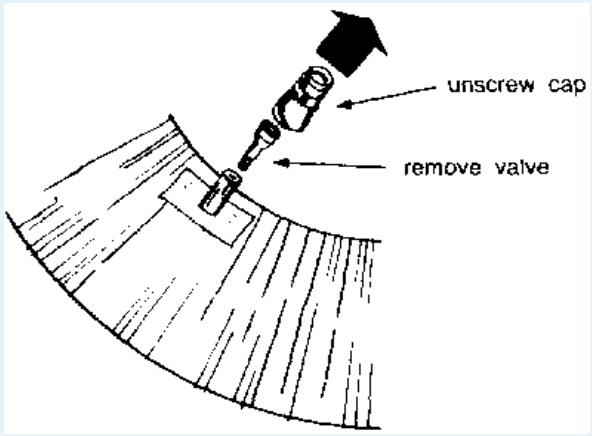
PREPARING INNER TUBES

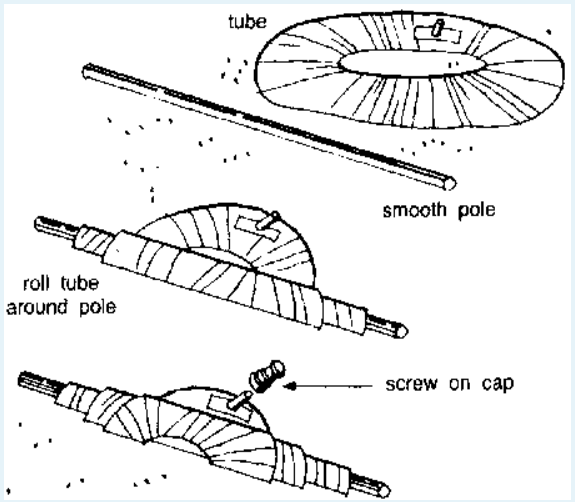


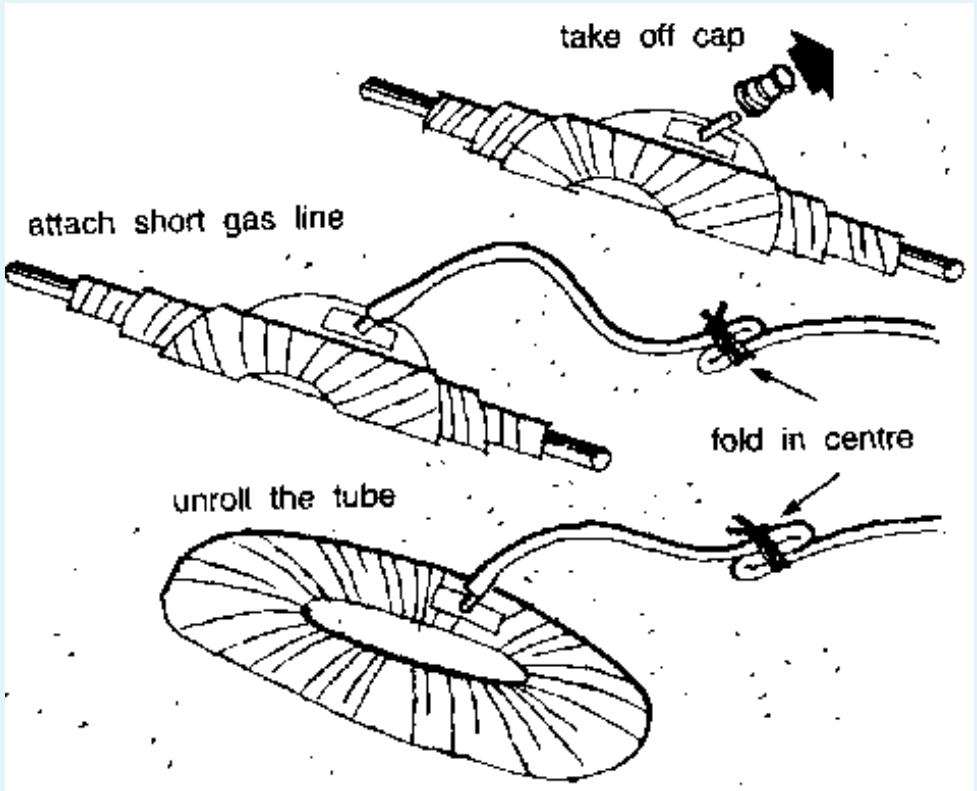


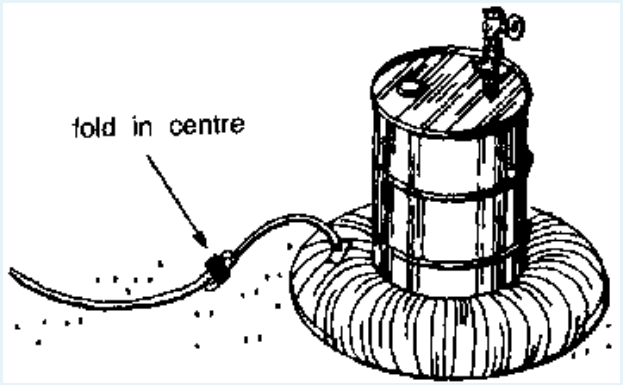


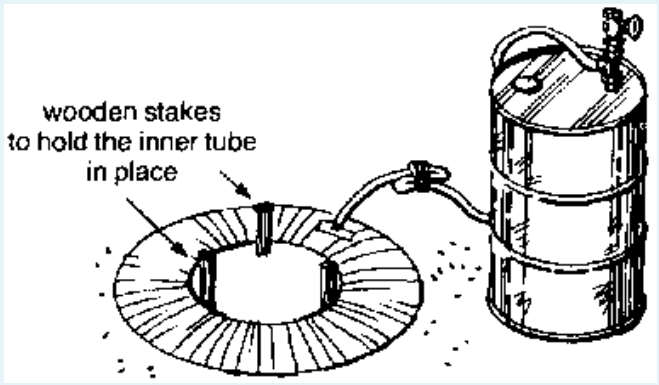


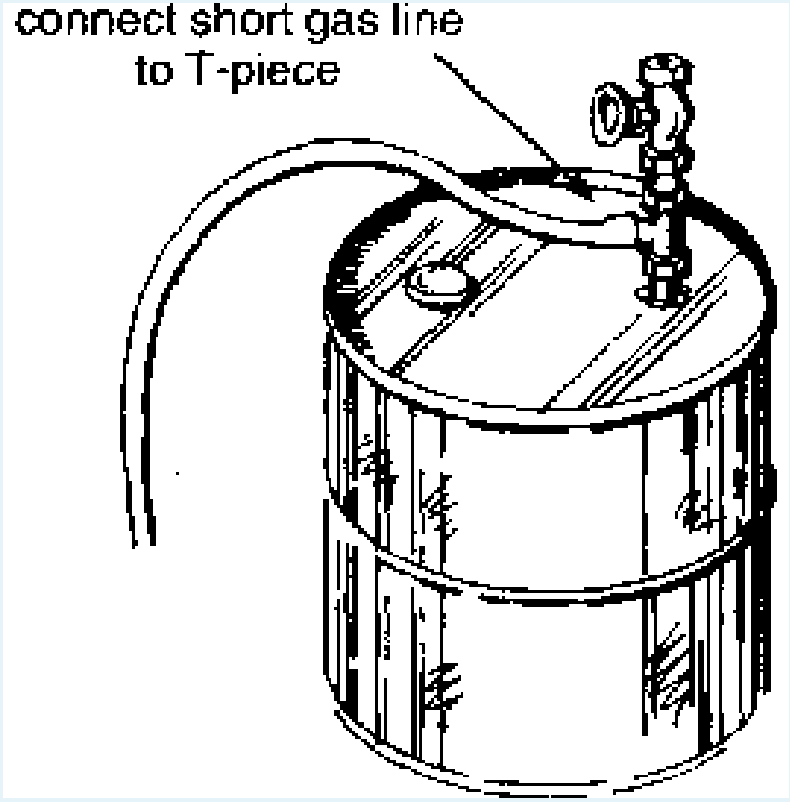

unscrew cap
remove valve

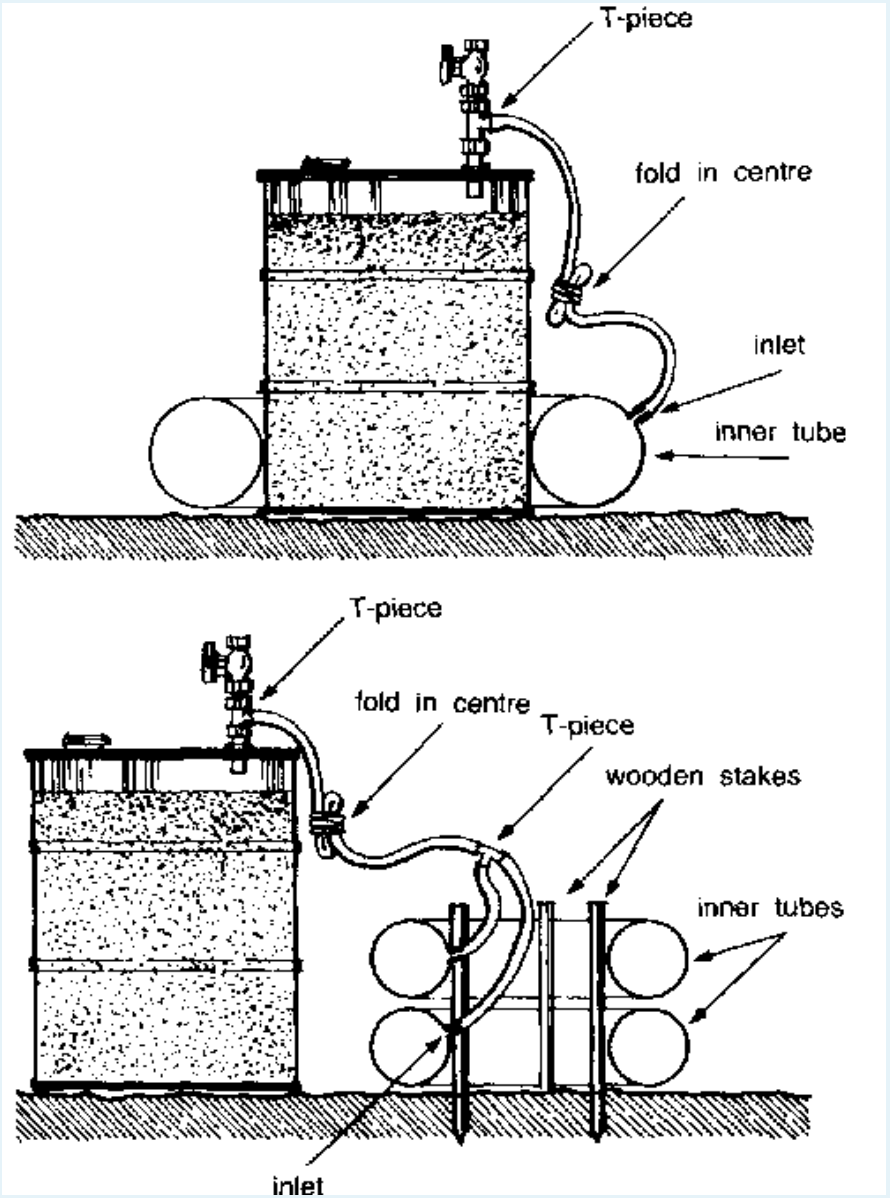

tube
smooth pole
roll tube
around pole
screw on cap


take off cap
attach short gas line
fold in centre
unroll the tube


fold in centre


wooden stakes
to hold the inner tube
in place


connect short gas line
to T-piece


T-piece
fold in centre
inlet
inner tube
T-piece
fold in centre
T-piece
wooden stakes
inner tubes
inlet

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- http://home.eng.iastate.edu/~tge/ce421-521/ShyamGoswami.pdf