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Editorial

Availability of requisite quantities of energy for basic human needs is vital for sustaining a quality of life which is dependent in turn on quality and quantity of available energy. Mundane needs like cooking, lighting and space heating etc. require energy in the domestic sector and likewise water lifting, agro-processing, construction of houses, roads, field-channel, industrial prime movers etc, in the productive sector, consume energy. High quality commercial energy like electricity, cooking gas and fuel oils are largely available to the urban areas whereas the rural areas get a proportionately small share and have to contend with non-commercial fuels like agrowastes, forestry residues, cattle dung and fuel wood (which is increasingly becoming commercial). It would thus be seen that the standard of living, as also the purchasing-power, has a strong correlation with energy consumption level. It is also true that even if there is abundant commercial energy available it could well be outside the purchasing power of poor households. The problem is more acute in rural areas because the productive sector suffers from low productivity due to inadequate infrastructure as well as insufficient energy supplies. Community facilities like hospital, schools, transport, servicing and repairs facilities in rural areas which too demand their own share of energy supplies, are also at a fairly low level as compared to those in cities and towns. These two problems, have affected rural productivity and purchasing power setting in process a vicious circle where low purchasing power restricts sufficient energy availability (for basic needs) and vice-versa. It is a happy augoey to note that Planning Commission, Govt., of India is siezed of this problem and some efforts are being made to tackle it through the Integrated Rural Energy Plan under which 224 Community Development Blocks have been covered so far in the country. Though the programme of I. R. E. P. has only made demostration of some energy conserving/renewable energy technologies like efficient chulha, Solar Street lights, Wind battery chargers, etc., it is yet far away from making a sizeable impact on meeting energy supplies at household level. It is now increasingly felt that in order to achieve this, particularly in the backdrop of the foregoing analysis, energy projects of any kind alone will not be able to tackle the problem. They will have to be judiciously integrated for household and for productive activities. Micro level plans will have to be developed for integrated development of villages wherein self-reliant and sustainable productive systems will have to be evolved which gradually increase household income and purchasing power and assure adequate energy supplies within the economic reach of the rural households. Many village development sehemes and project abound in the government and voluntary sectors both. There are also isolated success stories. But there are two main problems—one the model and pace of economic growth in most of the so called successful cases is not fast enough to elevate the household—economic for providing a reasonable standard of living and secondly it is not replicable even in a micro-region. It is therefore incumbent upon the planners and thinkers, in Government and Voluntary Sectors both, to design such a viable models and pilot them throughout various regions and sub-regions of the country on war footing. For we should not forget that socio-economic growth as well as distributive justice in the rural areas, if not tackled in such a way. The presently escalating tumult of the country side will go out of hand. It has already reached alarming proportions.

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BIOGAS GENERATION FROM BIOMASS RESIDUES – AN OVERVIEW

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This paper deals with biogas generation, factors affecting anaerobic digestion process, types of biogas plants, starting of a biogas plant, precautions to be followed during start up and the use of digested slurry as fertilizer. Emphasis is laid on augumenting cattle dung with biomass based feedstocks for biogas generation. The work done at AHEC on this aspect is dealt briefly.

INTRODUCTION

In recent years, there has been an increased interest in the development of technologies for harnessing renewable energy sources. Biomass in the form of organic residues, constitutes a major source of energy among all renewable sources i.e. Hydro, Wind, Solar, Geothermal etc. Crop, forest, domestic, sewage & municipal solid wastes & industrial effluents are some of the biomass residues available for biogas generation. Thermochemical as well as biological methods can be used to produce energy from such residues. One of the biological processes i,e. Anaerobic digestion of organic residues has received a new fillip in recent years since the energy crisis of early 70' s, especially following the recent Gulf War. The product of anaerobic digestion is a fuel gas "Biogas" consisting of mixture of methane & carbon-dioxide, while the effluent slurry is a fertiliser. In India, the work on the development of biogas plants using cattle dung was initiated by the Khadi & Village Industries Commission (KVIC) as well as the Gobar Gas Research Institute, Ajitmal & led to the development & commercialisation of KVIC (Floating dome) design & fixed dome Janta design. A number of both family & community size biogas plants have been installed through state & central agencies under National Biogas Programme as well as the programme launched by Department of Non-Conventional Energy Sources, Govt. of India.

This paper attempts to discuss briefly the principle & microbiology of biogas generation, types of biogas plants, starting of biogas plants, precaution to be adopted while running the plants & further scope of crops and forest residues in biogas production.

PRINCIPLE OF BIOGAS GENERATION

Anaerobic digestion of complex organic residues is a multiphase biological process brought about by the integrated action of a heterogenous population of micro-organisms. Four distinct tropic groups with clearly defined & different carbon metabolising functions have been recognised (Fig. 1).

Although, the multiphase nature of digestion is now widely accepted, the complete process is often considered to consist of two main stages : (1) A Hydrolytic & fermentative stage & (2) a methanogenic stage. In the former stage, organic polymeric compounds are metabolised by hydrolytic & fermentative micro-organisms to a complex mixture of volatile acids, neutral compounds & carbon-dioxide. The co-ordinated activity of the second stage bacteria, the obligate proton reducers, the acetogens & the methanogens, subsequently converts these products to methane & Carbon dioxide (Colleran Emer, 1980).

The heart of the anaerobic digestion process is the microbiological conversion of the organic constituents of wastes to methane. The chemistry, involved, for any general waste carbohydrate material, may be represented by the following generalised equation :

$$C_n H_a O_b + (4n-a-2b)/4H_2O \rightarrow (4n-a+2b)/8CO_2 + (4n+a-2b)/8CH_4 \quad ...(1)$$

MICROBIOLOGY OF ANAEROBIC DIGESTION

Anaerobic digestion has been described as a three step process in which complex organic materials are converted to end products of methane & carbon-dioxide (Fig. 2). Groups of micro-organisms are responsible for this conversion. The first group of organisms is collectively known as Acid formers or Acidogens. These bacteria convert large molecules such as proteins, starch, cellulose into organic acids. The organisms performing these steps are both anaerobic & facultative in nature. The last step is the conversion of these acids to methane & CO_2 which is performed by a group of organisms collectively, called methane former or methanogens which are strict anaerobes, because, methanogens grow more slowly than acidogens. Hence the former process is termed as rate limiting step. The pathways by which this overall reaction occurs is shown in fig. 3. For every mole of glucose utilised, 3 moles each of methane & 3 moles of CO_2 are produced (Konstandt, 1976). For other substrates, the proportions of CH_4 & CO_2 produced are different. For example, the conversion of proteins yields a mixture with 75% CH_4, while conversion of fats yields a gas mixture with 70% CH_4. Thus, conversion of a complex substrate yield a gas which is typically 50-60% CH_4 & 40%-50% CO_2.

TYPES OF BIOGAS PLANTS

A large number of small digesters have been built in India, China & Taiwan, but it is not certain how many of them are running or running efficiently. The Indian digesters are based on the design of J. J. Patel. The design was developed under the patronage of KVIC which has also been instrumental in the spreading of digester technology, although other agencies are also concerned with this technology.

KVIC MOVING DOME TYPE

A typical biogas plant is a brick lined cylinder constructed under the earth, with a wall dividing the cylinder into two & with inlet & outlet ports leading to the bottom of the tank. The top consist of a gas storage dome floating in the digesting slurry or a separate water channel. Stirring may be accomplished by convection current & gas circulation in the digester slurry & by a paddle attached to the gas holder. The rise & fall of the paddles break up the crusts. Else the holder can be moved backward & forward by hand at intervals to break up the surface scums. The gas is taken out from the top of the dome via a flexible pipe to short runs of rigid piping leading directly to the gas burners, Condensate pots in the gas lines are recommended.

The feedstock is usually cattle dung and/or human excreta. Here the digestion is slower than in the heated, stirred & high rate digesters & detention times of about 50 days appears to be common. However, there are variations, particularly, as the diets of the animals are often poor. Gas production per animal could be less in the case of poorly fed animals. A family size plant is of generally 2 m^3 size, bigger plants are more viable & are suitable for institutional use.

JANTA TYPE (CHINESE MODEL) BIOGAS PLANT

Digesters of Janta type are built underground with a gas reservoir of fixed volume and hence, the gas pressure varies. While constructing the digester, attention is paid to making the whole digester water and gas tight by applying layers of cement or mortars of various types. Loading is done by hand down one side pipe and unloading is done by a bucket up the other pipe. Loading in such plants must be regular and the timetable for loading, once decided upon must be followed strictly. As the digesters are climatically heated, gas production varies with season and location of the digester. As there is no stirring, some scum formation might be expected. Users are therefore, required to watch the U-tube manometer on the top of the digester and to make sure that the pressure is between certain marks before using the gas.

Another most common design has a top built with a skirt which acts as a gas holder in the same way as in the gas domes of the Indian designs. The skirt projects either below the digesting sludge or into a separate annular water trough to form a gas seal. As the gas is produced and utilised "the floating top" rises and falls to give varying volumes of gas at a constant pressure (6-11 inch WG), which allows for piping the gas to the site of use, for example in the burners or engines without complicated pressure valves. Even if the digester top is floating in the digesting slurry. little gas is lost from the annular spaces, as the slurry here tends to crust over or become covered with rain water and there is very little microbial activity.

FACTORS AFFECTING DIGESTER'S PERFORMANCE

Stirring :

Stirring ensures that (i) the digester contents remain relatively homogenous (ii) input is mixed into digester and (iii) the digester contents have an even temperature throughout the digester. Stirring is also necessary for removing the surface scum formed owing to the presence of solid particles of various sizes and densities in input slurry as well as lighter particles of fats and oils (e, g. in domestic sludge which floats to the top.

To prevent floatation and settlement as far as possble, mixing systems are provided for up and down circulation of the digester content to bring about surface turbulences as well as to enable the heavier particles to float to the top.

Basically, there are three methods of mixing and several types of mechanical setups. While it is possible to mix a small digester by means of one or more paddle or flat blade turbine stirrers, it is almost impossible to mix a large volume of thick sludge by this method. In such cases, a suitable stirring mechanism may be used, which results in considerable enhancement of biogas production.

SOLID CONCENTRATION

A solid concentration of 8—10% (w/v) has been recommended as optimal for rapid generation of gas. A higher concentration retards gas production, while low concentration results in lower gas production owing to lower loadings at optimum retention time. Since biogasification process is microbiological in nature, the solids in the input slurry influence the mixing of micro-organism with organic substrates fed to digester.

DETENTION TIME/RETENTION TIME (RT)

The duration for which a particular portion of the feedstock. added to the digester system remains in the digester is known as detention or retention time (RT). The RT of the system expresses the volume of fluids in the reactor/volume of fluids passing into and out of the reactor per day. The retention time of the existing biogas plants is usually 55 days. However, maximum gas production occurs within the first four weeks and decreases gradually. The volume of gas produced per unit waste increases rapidly with increase in retention time upto a threshold point. The relationship between the volume of digester (U) and retention time (t) has been worked out (Eq. 2) (Chan and Pearson, 1981 ; Sarkar, 1982).

$$U = \frac{c(1+D)\,tf}{yd} \quad \ldots \quad (2)$$

where

- c is the desired capacity of plants (cu. ft. of biogas/day) ;
- D is the weight of water added to the unit weight of wet dung ;
- t is the temperature of digester contents ;
- f is the fermentation period in days ;
- y is the yield of gas/unit weight of dung ; and
- d is the density of dung-water mixture.

The equation shows that U is proportional to tf/y and that increase in temperature of digester content within a certain range reduces the RT and increases the gas yield. A longer RT would need a bigger digester involving much financial involving much financial investment. Therefore, an optimum RT of 55 days is suggested. which would balance the cost of construction of a larger digester against the value of additional gas produced.

REACTOR LOADING RATE

The reactor loading rate is the rate at which organic waste is supplied to the reactor volume. It is related to RT and percentage of organic matter in feedstock as shown in eq. 3 ;

$$\text{Reactor loading rate } (\%) = \frac{\% \text{ organic matter in feed}}{RT} \quad \ldots\ldots(3)$$

Thus, the reactor loading rate can be increased at a given RT by feeding more concentrated slurry of organic matter or at a given percentage of organic matter by shortening the RT. At high loading rates more CH_4/volume of reactor is produced but less CH_4 mass of feed because of less percent of Volatile Solids (VS) destruction. Lowering the loading rate will result in an increase in percent VS destruction, but less CH_4/volume of reactor is produced.

TEMPERATURE

With mesophillic flora, digestion is most satisfactory at 30°—40°C while with thermophiles, the optimum temperature range is 50°—60°C. The temperature to be used is influenced, essentially, by climatic considerations. In general, there is no thumb rule, but for optimum process stability, the temperature should be carefully regulated within a narrow range. Sudden temperature changes can disrupt the methanogens. Once the bacteria are adapted to a particular temperature, this should be controlled as strictly as possible because efficiency fall, if bacteria are subjected to above sudden temperature changes. Hence, the gas production goes down during winter. In such cases. or in hilly areas, it is a common practice to bury the digesters in the ground, because of the insulating properties of the soil. Green house covering can also be used if the digester is not buried. Costs can be minimised by using natural materials such as leaves, saw dust, straw and the like which are composted in batches in a separate compartment around the digester. Alternatively, solar heated water may be circulated through coils embedded in the digester itself, to maintain the desired temperature with the achievement of maximum gas production (Reddy et al., 1979).

pH

A pH of near to 7.2 is required for normal operation of a digester and is a favourable medium for the growth of methanogenic bacteria (Ghosh and Klass, 1978). Once the digestion process sets in, the pH reaches neutrality and the entire suspended slurry becomes buffered. If the pH of the digester falls owing to excess charging of digester or by some other means, the digester should be temporarily emptied of digested slurry followed by recharging with fresh organic substrate & seeding medium.

C/N RATIO OF FEEDSTOCKS

The maintenance of optimum microbiological activity in the digester is crucial for gas generation and is related to the availability of nutrients. The two most important nutrients or carbon and nitrogen and a critical factor for raw material is the overall C/N ratio. Domestic sewage and animal and poultry waste are examples of N-rich materials that provide nutrients for the growth of anaerobic organisms. N-poor materials like green grass, straw are rich in carbohydric substrates that are essential for gas production. In practice, it is important to maintain a C/N ratio close to 30:1 (by wt.), which is essential for an optimum rate of digestion (Stout. 1979). The C/N ratio can be manipulated through combination of materials that are low in carbon with those that are rich in nitrogen or vice versa. Excess N inhibits bacterial growth due to NH_3 formation. Toxicity due to NH_3 can be remedied by adjusting the C/N ratio of animal wastes by adding shredded biomass residues like bagasse or straw or by dilution.

COMPOSITION OF FEEDSTOCKS

Biogas can be generated from sewage sludge, food processing wastes, crop residues, animal wastes, kelp & aquatic plants. Among the various non-commercial sources, biomass is important because of its potential to get converted into various energy forms. The major constituents of crop biomass residues, that can be effectively used as feedstock for biogas plants, are cellulose and lignin. Biogas production is greatly dependent on the substrate and the period of digestion. The reported methane content in biogas from gobar is between 55 and 60%, the rest being mostly CO_2. One possible way to increase the availability of hydrogen is to use easily digestible volatile solids. These divert more carbohydrate intermediates into methane rather than CO_2. Studies for determining the potential of various crops & forest residues for biogas generation, conducted at AHEC, have shown that methane content in biogas is as much as 72% indicating that feedstock characteristics affect the biogas generation considerably and result in the enhancement of quantity as well as quality of the gas.

In any anaerobic digestion process that is not inhibited or kinetically limited, two major factors affecting methane yields are feedstock composition & characteristics. Biodegradable organic compounds, e. g. fats & proteins produce a higher percentage of methane than oxygenated compounds such as sugars. The ultimate CH_4 yield is influenced principally by the biodegradability of organic compounds. Certain natural organic compounds such as lignin are inert/passive to decomposition under anaerobic conditions even at longer residence times. The refractory property is related to the lack of enzyme to carry out initial hydrolytic reactions. It has also been established that certain compounds can complex with others rendering them resistant to anaerobic digestion. i. e. lignin affects cellulose decomposition. A variety of physical, chemical & biological treatment techniques are being evaluated to improve biodegradability. Since most of the pretreatment techniques developed are for the conversion of biomass to ethanol, the application of these methods to anaerobic digestion has been minimal & needs further investigation.

NUTRIENT CONCENTRATION

The net growth of microbial cells is directly related to the concentration of nutrients, e. g. C, N, P, S, alkali metals, etc. Cattle dung, however, contains a sufficient amount of nutrients which may not be the case for many other biomass/waste materials. Space and McCarty (1964) observed exceptionally high rates of acetate utilisation as a result of the addition of Fe, cobalt and thiamine. Khan and Taoitier (1971) stated that a sulphur source of about 0.85 mM concentration in the form of SO_4^{-2}, thiosulphate, sulphite, cystine or methonine is essential for the degradation of cellulose to methane, since sulphur for forms an integral part of Ferrodoxin and co-enzyme M.

The addition of Phosphoric acid at a concentration of 2.24 g/kg of slurry of fresh manure, has been found to be effective in enhancing the biogas generation (Lanyon et al., 1985).

VOLATILE ACID CONCENTRATION

The volatile acid concentration in the input slurry should not go beyond optimum 2000-3000 mg/litre beyond which methane formation drops. The excessive volatile acid formation is caused by high loading rates, sudden drop in temperature & scum formation. Alkaline chemical e. g. Ca $(OH)_2$, NH_4OH are needed to over come exessive acid formation.

STARTING A BIOGAS PLANT

There are basically two methods of starting a digester either with or without an inoculum or seed Animal waste does not need any inoculum or seeding, because the waste contains necessary bacteria which may not be in correct numbers while vegetable, crop, forest & factory wastes need an inoculum for smooth running of a digester. Before filling the digester with feedstock, the digester should be checked for leakage by filling it with water and observing the drop in level. The leakage should be first plugged with cement. The gas leakage from gas holder/fixed dome at various points must also be checked and rectified. The plant is now filled with feedstock-water slurry prepared to the required level. The seeding of the digester involves the use of an adequate population of both the acid-forming and methanogenic bacteria. Active digesting sludge from a sewage plant constitutes 'ideal seed' material. As a guideline, the seed material should be twice the volume of the fresh manure slurry during the start up phase with a gradual decrease in addition over a three weeks period (Da Silva, 1981). The growth of methanogens, and hence gas production, is often inhibited by overloading, low pH and fluctuations in temperatures. The slurry must also be seeded properly if crop/vegetable wastes are to be used. The digester should be completely filled in a single time filling or filled in a minimum possible time, so that the gas generated will not escape into the atmosphere. To start early generation of biogas, a sufficient quantity of fermented slurry from a plant already in operation should be added.

After filling, the digester is allowed to remain in that state for 25-30 days during which period the fresh slurry gets digested to produce gas at normal level till the gas burns with a blueflame, Prior to this. all the gas is vented to the atmosphere to avoid any explosion due to the presence of oxygen in biogas. After the formation of inflammable gas, the daily feeding of the plant should be started with a slurry of desired proportion of feedstock & water. During daily feeding, the gas outlet at the top of dome gas holder should be kept opened & closed after the feeding is complete. After the steady state is reached, the plant starts operating at its rated capacity. A water seal may be provided in the gas piping to remove periodically the condensed water from the pipeline.

PRECAUTIONS

The following precautions must be taken during the operation of a biogas plant.

(1) Excessive pressure build up inside the digester should be avoided, as it may cause excessive expulsion of slurry and gas release from the sides of the digester.

(2) Inhalation of the biogas must be avoided.

(3) In the case of KVIC design, the scum formed on the surface of slurry must be broken by rotating the gas holder. The sides of the gas holder must be cleaned with water at least once a week. The gas holder must be co ted with red oxide paint followed by bitumen paint after complete drying of the primary paint.

(4) The gas burner cock must remain closed even if the gas supply is cut off from the plant.

USES OF DIGESTED SLURRY

The spent slurry obtained from the biogas plant is a good fertilizer. The digested slurry may contain lignified fibres which are anaerobically undegradable or are only slowly degraded by anaerobic microorganisms. The fibrous material has itself no or little value in terms of fertiliser (N,K,P), but acts as a source of humus and as a soil conditioner. The chemical composition of the outcoming slurry is Nitrogen (1.5% as N). Phosphorous (0.4% as P_2O_5), and Potassium (2.2%, as K20), which, however, varies from place to place. There are however, two ways of applying this digested slurry as manure :—

(1) The slurry, as obtained from biogas plant, can be directly applied to the soil by mixing it with irrigation water. Thus no loss of nitrogen occurs and it is available to the plants in the form in which the plants require it.

(2) After exposing the slurry to sun or weather, the slurry can be applied to the soil. There is considerable loss of nitrogen during its drying or exposure to the atmosphere.

If the amount of slurry obtained is larger than what is required, it can be used for rapid fermentation of compost. For this purpose, a number of pits are dug near the gas plant. The slurry is led to these pits through channels. Initially, a layer of vegetable wastes e. g. leaves, stems, etc., is dumped into the pit and then a layer of digested slurry is spread over the layer of vegetable wastes. Again a layer of vegetable waste is provided over slurry level followed by spreading of slurry over it. The spreading of vegetable waste and slurry is continued till the pit is completely filled. Thereafter, the digested slurry is fed to the second pit and the process is repeated. During the process, a large number of bacteria and the nutrient material in the slurry accelerate the process of composting and reduce the decomposition time of organic residues to half of the normal period. It is found that the addition of 1.5% powdered rock phosphate or other phosphatic fertiliser to the compost (made from vegetable wastes and digester slurry) accelerates the rate of decay and enriches the quality of the product.

When there is no immediate use of the slurry, it may be led into a series of pits one by one. When the first pit is full with slurry collected over a period of time, the next one is filled. By the time, the second and third pits are full, the first one would be dry enough for using as manure. The pit can be used again, for filling. In this process, some nitrogen is lost (which is much less than sun drying), but the handling and disposal of manure are easy.

FUTURE SCOPE OF THE TECHNOLOGY

The development of biogas technology is meant not only for energy and manure production, but it also finds use in environmental pollution control and organic waste management. Furthermore, it plays a significant role in rural development. The area of research needing attention, in future, would be the biological fermentation characteristics of feedstocks, digester design, digestion reactions, operating conditions. Kinetic, study, purification of biogas and use of digested slurry. There is a growing need to undertake R and D for optimising anaerobic digestion processes for the treatment of a wide variety of organic wastes with emphasis on maximising methane gas production. Owing to variations in physical and chemical compositions of feedstocks, a variety of digestion concepts have come up, ranging from simple to highly complex processes. The concepts include single stage, two stage, contact, attached film and multistage processes, and biomethanation. The later biomethanation process is actually an anaerobic digestion process in which CO, CO_2 and H_2 are converted to methane. (Wise et al., 1978) according to the following equations t

$$CO + H_2O \longrightarrow CO_2 + H_2 \text{ and}$$

$$CO_2 + 4H_2 \longrightarrow CH_4 + 2H_2O$$

Getting better public acceptance calls for in depth studies on socio economic aspects, development of efficient mass communication systems and training of personnel in the construction, operation and maintenance of biogas plants.

BIOGAS PRODUCTION FROM AGRICULTURAL AND FOREST RESIDUES

Though a number of residues like animal excreta, domestic sewage, municipal solid wastes, industrial wastes and aquatic plants can be efficiently used as feedstocks for biogas generation, crops and forest biomass residues have a significant importance in biogas generation and therefore, need immediate attention.

The Agri and forest biomass can be used as a second waste to augment gas production from a digester normally running on other feedstocks. To overcome seasonal deficiencies in the production of the waste, the material could either be stored or grown purely as digester feedstock for large scale gas production systems.

Literature reveals that biogas production from crops and crop residues is economically competitive with all premium fuels but is not yet competitive with natural gas and propane available from gas fields. A 45.5 m^3 single stage stirred-tank digester loaded with a slurry of vegetable wastes of 10% total solids (TS) and a detention time of 15 days produces about 136 m^3 gas/day, with 70% CH_4 content. About 19 m^3 gas is used for digester heating leaving a surplus of 117 m^3 gas. The gas yields around 0.45 m^3/kg of TS added which is about double that obtained from cattle dung.

Investigations have been conducted at the Alternate Hydro Energy Centre to anaerobically digest seven different biomass residues in laboratory digesters. (Sharma et. al. 1987, 1988, 1989, 1990, 1991). Experiments were made under controlled conditions of pH and temperature with an RT of 55 days. All the biomass residues yielded more than double the amount of biogas compared to cattle dung. A pilot plant of 6 m^3 capacity (Janta model) was operated using *Ipomea* plant (optimum particle size) and cattle dung mixed in a predetermined ratio. The plant yielded about 5.0 m^3 gas per day as against 3.2 m^3 gas/day from cattle dung in a steady state operation. This study shows that there is ample scope for using agricultural and forest biomass residues as feedstock for biomass production.

Improvements in the efficiency, rates of gas production and reduction in digester costs are some possible problems which need to be solved in the near future. The rapidly developing understand of the microbial and biochemical processes involved, especially, those involving ecological relationship, will be of great value in bringing about further improvement. Applied research in further should, therefore, be directed to developing more efficient and cheaper reactor designs and automatic and less expensive reactor operations.

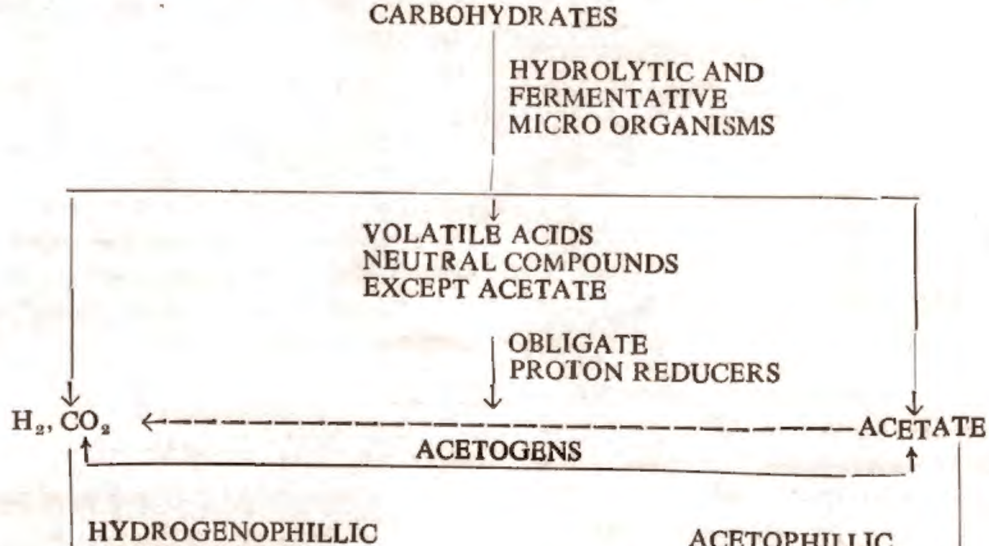

FIG.1—STAGES IN ANAEROBIC DIGESTION

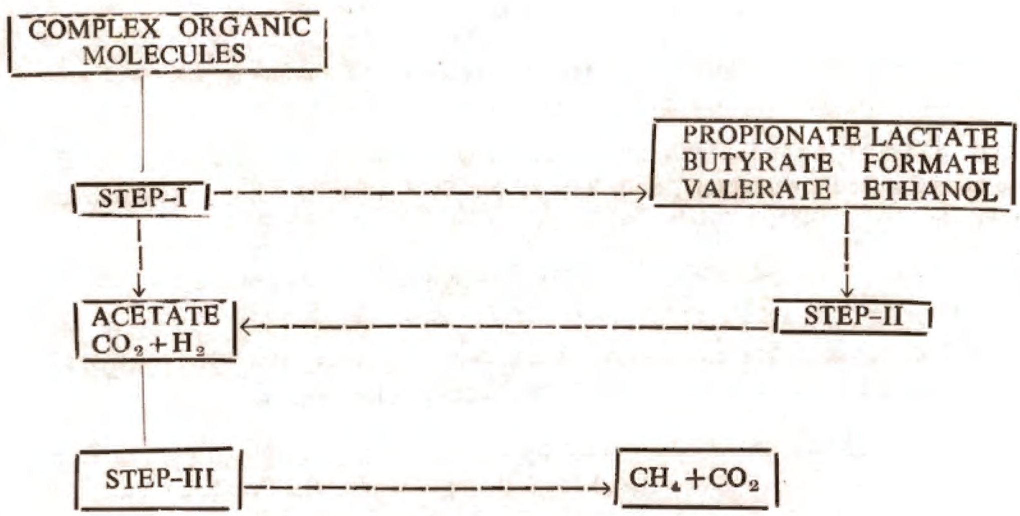

FIG. 2—ANAEROBIC DIGESTION OF COMPLEX ORGANIC MOLECULES TO CH_4 AND CO_2.

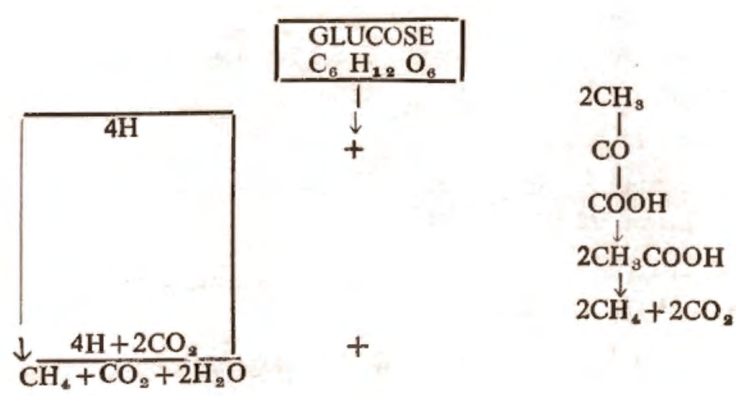

FIG. 3—MECHANISM OF CONVERSION OF GLUCOSE TO CH_4 AND CO_2 VIA ANAEROBIC DIGESTION.

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DEVELOPMENT OF EFFICIENT FEED SUPPLY SYSTEM OF THE MOBILE STIRLING ENGINE

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The Stirling Engine can make a major contribution to energy conservation and improved energy conservation using agricultural wastes which do not require expensive and extensive processing. However, based on actual working of stirling engine mounted on the mobile carrier for on farm applications various limitations in different systems have been observed. The feed supply system requires major modification to use wide varieties of biomass. This paper deals with modification carried out in feed supply system of existing stirling engine in terms of design, development and testing of different type of screw flights.

INTRODUCTION

In recent years much stress is being given to the research and development of new and appropriate energy sources, which are renewable in nature, pollution free as well. This will ease the rising demand of petroleum energy in various sectors. In our country huge amount of agriculture wastes like saw dust, rice husk, other cheaper and non-usable biomass is available, which can be used as fuel in the stirling engine for decentralised power generation.

Presently a Hamara Model ST-5 engine of capacity 5 BHP at 650 rpm working on 5 bar mean effective pressure is being manufactured by M/S Stirling Dynamics, Madras and it is in common use. The Renewable Energy Centre has developed a mobile chasis coupled with auto cooling system converting existing stirling engine for on farm applications such as threshing, water pumping, chaff cutting and electricity generation etc. (Fig. 1). During the operation of mobile stirling engine various problems in feed supply, combustion, cooling and starting system have been observed (1), It has been observed that feed supply system requires immediate attention for modification because the system based on augur renders it unsuitable for mixed biomass. In order to accomodate wide varieties of biomass different types of screw flights were designed and mounted at the bottom of hopper.

METHODS AND MATERIALS

Mainly the modified feed supply system, consists of a feed hopper, housing of screw conveyor, feed inlet pipe, feed control plate, belt pulley arrangement and frame. Viewing to different characteristics of fuel four types of screw conveyor flights were developed. These include cut and folded flight screw conveyor, paddle conveyor screw, stainless steel conveyor screw and long pitch conveyor screw. The specifications of feed supply system and different type of conveyor screws are given in Table I, Fig. 2, and Fig. 3 respectively.

Table 1—Specifications of modified feed supply system

(a) Size of hopper	: 850 × 600 × (350 × 200) mm.
(b) Size of feed conveying diameter	: 50 mm.
(c) Inlet opening	: 115 × 50 mm.
(d) Outlet opening	: 30 mm.
(e) Speed of screw conveyor	: 18 - 30 rpm.

The cut and folded flight screw conveyor system provided folded segments which act as lift to produce a cas-cading effects. It promotes agitation and aeration, resulting in better mixing. These types of conveyor system used for light and medium weight, fine, granular and flaky material such as saw dust. The paddle conveyor screw system have steel blades mounted on rod shanks inserted through the pipes. These types of screw are used for mixing, blending and stirring dry and moist material. The medium size chaffed biomass can easily be conveyed through the paddle conveyor system without affecting flow rate. The long pitch type conveyor is fabricated to handle material such as long sized chaffed which requires blending and stirring during movement. Similarily stainless steel screw conveyor is suitable for conveying rice husk material which require proper stirring during movement. The designed conveyor system are tested for type of fuels at different speed and different flow rate.

TESTING OF SCREW CONVEYORS

The power requirement for different conveyors for conveying the different feeds are measured atdifferent speed such as for saw dust, rice husk and cut chaff. The conveyor screw to be tested was connected to a motor drive via a variable speed drive mechanism. The block diagram of the set up for testing is shown in Fig. 4. The experiment were performed at varying speed i. e. at 18, 22, 26 and 30 rpm. The average power requirement for different conveyor is given in Table 2.

Table 2 : Power requirement for different screw conveyor at different speed.

S. No.	Type of fuel	Screw conveyor speed rpm.	Total power required in-watt			
			cut & folded	Stainless steel	Paddle	long pitch
1.	Saw dust	18	180	212	—	—
		22	184	214	—	—
		26	193	121	—	—
		30	206	232	—	—
2,	Rice husk	18	212	167	—	—
		22	216	173	—	—
		26	225	180	—	—
		30	227	187	—	—
3.	Cut chaff	18	143	260	177	182
		22	245	264	181	187
		26	254	272	185	190
		30	260	277	188	194

RESULTS AND DISCUSSIONS

The power transmission in the existing stirling engine shows that about 200 watts of power is utilized in feed supply system (2). To make the operation of stirling engine efficient use of 200 watts of power for running the feed supply is ideal. Through experiments it worked out that cut and folded type for saw dust, stainless steel for rice husk, paddle type and long pitch type for cut chaff is suitable from power consumption point of view. In all these eases the power requirements was within 200 watts.

CONCLUSIONS

The stirling engine having modified feed supply system equipped with different flights to accomodate wide varieties of fuel can be one of the promising source for utilizing agricultural waste, which is available in plenty. It was observed that these screw conveyors are well suited for operating the stirling engine using locally available cheap biomass such as saw dust, rice husk, and cut chaff and threshed bhusa etc. The cut and folded type stainless steel, paddle and long pitch types conveyor are suitable for fuel like saw dust, rice husk and cut chaff/threshed bhusa respectively. However, few more suitable systems have been developed to make its working reliable convenient and efficient.

ACKNOWLEDGEMENT

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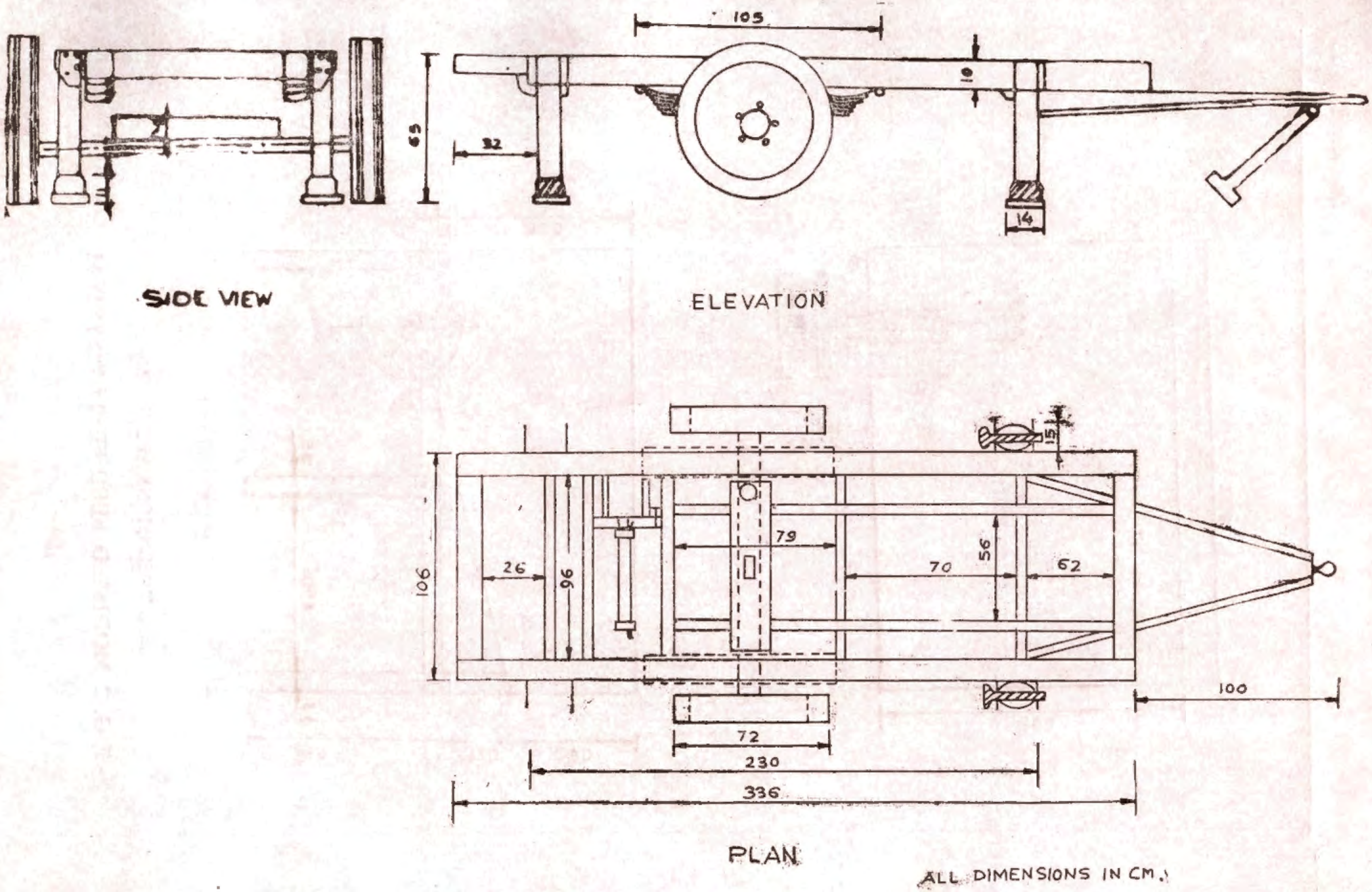
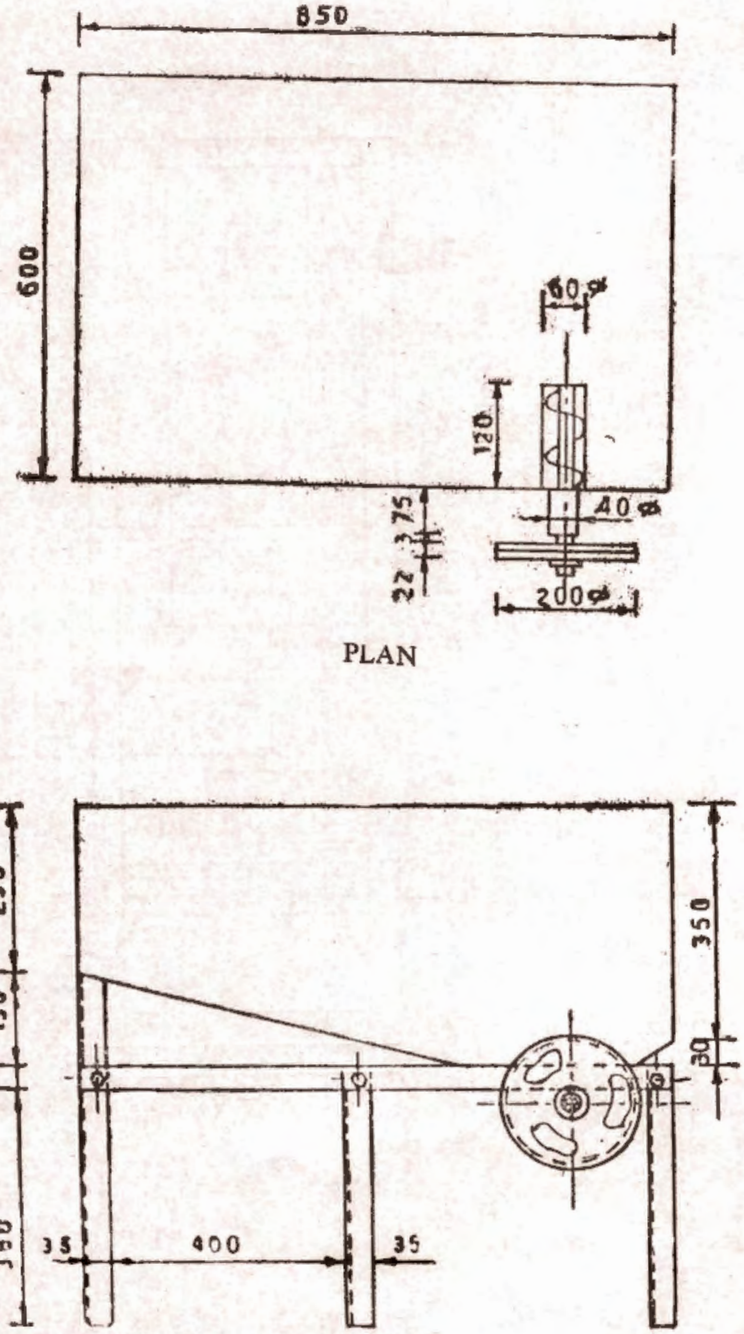


FIG. 1 MOBILE CART FOR STIRLING ENGINE



ALL DIMENSIONS ARE IN CM

FIG. 2 MODIFIED FEED SUPPLY SYSTEM

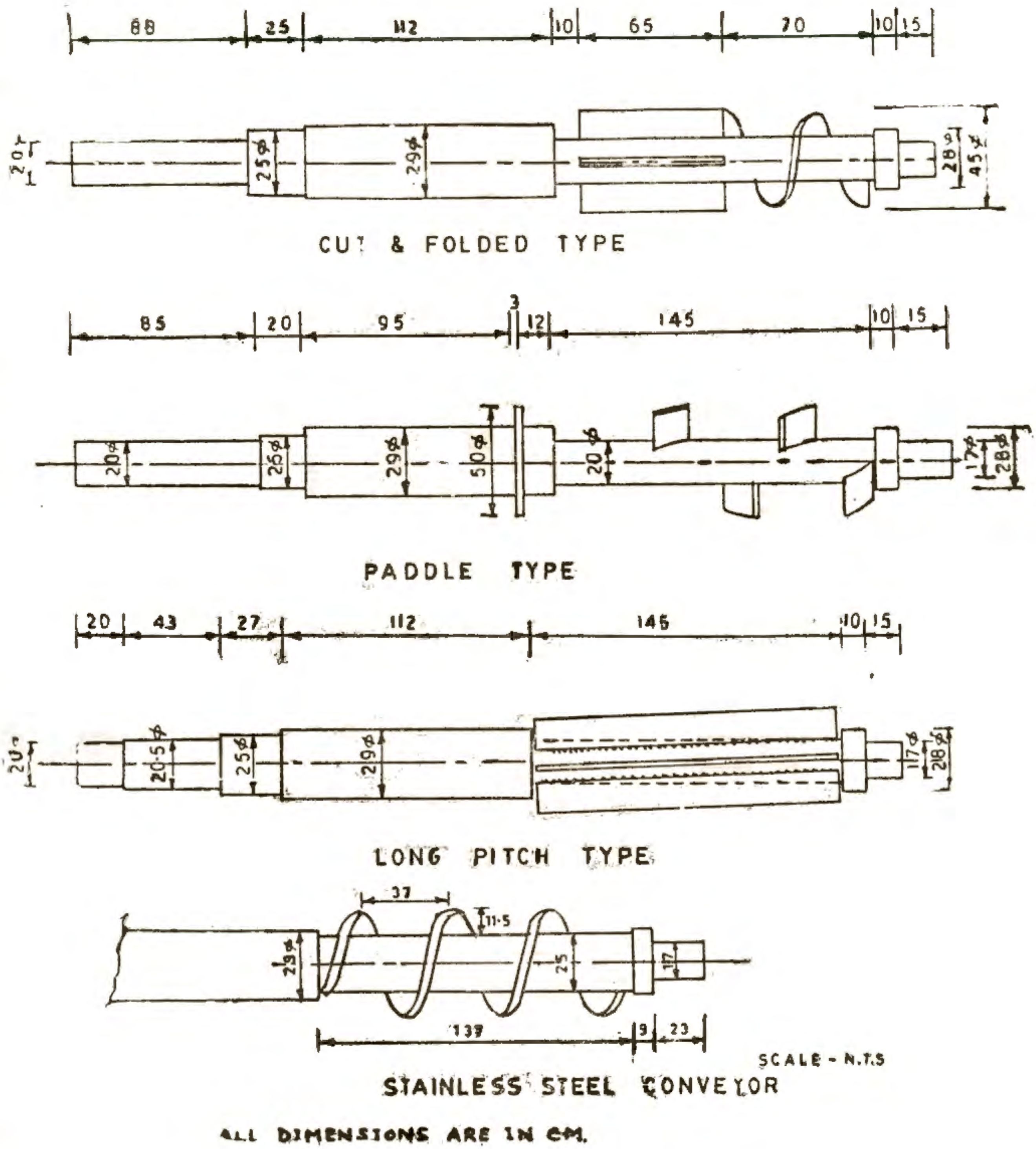


FIG. 3—DIFFERENT TYPES OF DEVELOPED CONVEYOR

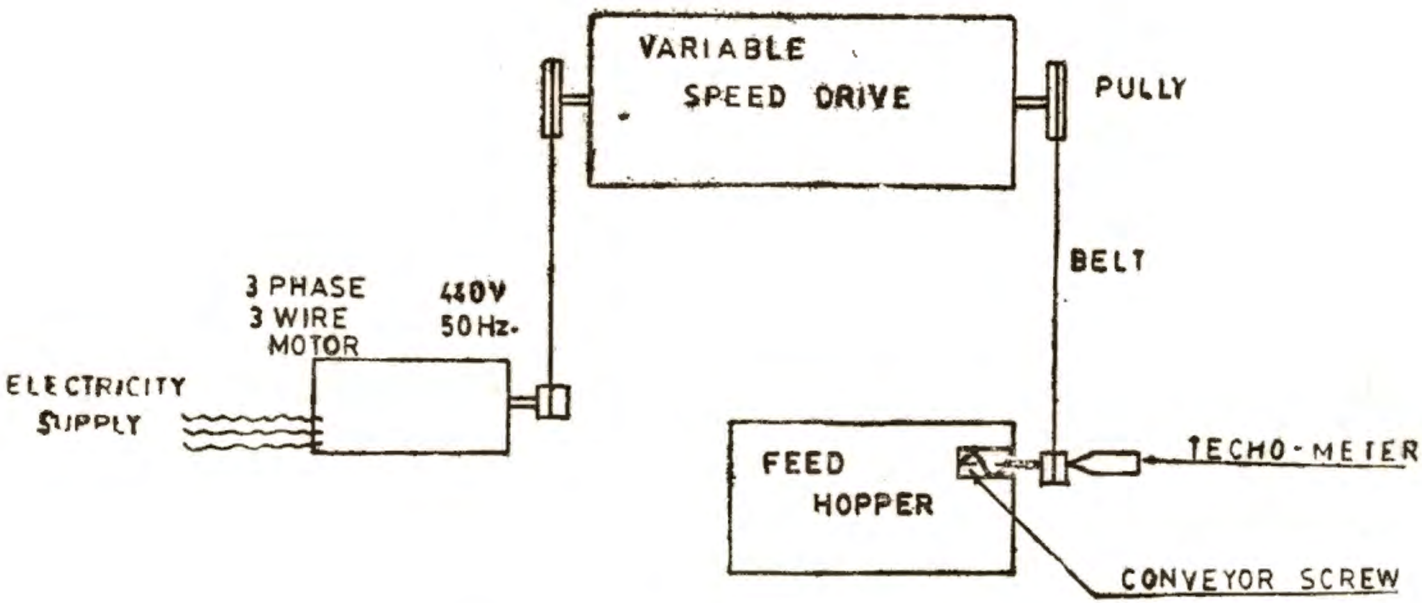


FIG. 4 BLOCK DIAGRAM FOR POWER MEASUREMENT OF THE DIFFERENT SCREW CONVEYORS

DEVELOPMENT OF TRAY TYPE ULTRA VIOLET STABILIZED PLASTIC SHEET COVERED SOLAR CABINET DRYER FOR RURAL AREAS

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The design details and performance of 200 micron ultra violet stabilized plastic sh et covered tray type solar cabinet dryer which can be used for dehydrating 50 kg. of fruits and vegetables are described in this paper. The cabinet temperatures of 34° to 55°C were recorded at Udaipur during the coldest days in the month of December. The field tests indicated that by the use of this dryer, the moisture contet of ginger can be reduced from 84 percent to 10 percent within 5 to 6 days. The efficiency of this dryer is about 15 percent This dryer can be used for dehydrating fruits and vegetables of rural areas where primary processing operations are almost absent.

INTRODUCTION

In India it is estimated that annually 24767 million tonnes of fruits and 73473 million tonnes of vegetables are produced, out of which only less than one percent is exported and about 25-30 percent goes waste before it reaches to consumer. This spoilage can be reduced by applying the solar technology in the rural produce growing area. In this view a variety of solar dryers based on the concept of forced convection are now available, but high pumping cost and related expenses alongwith non-awareness of various technicalities involved are the major obstacles to wide spread use of solar drying technology in rural area. Further, the solar dryers with glass sheet as solar window are expensive and heavy due to high cost and weight of glass covers. In the present study, glass cover of solar dryer was replaced by 200 micro ultra violet stabilized plastic sheet to reduce the cost and to achieve the transportability. The UV stabilized plastic sheet is resistant to deterioration of its transmittivity properties and be put to continuous use without any serious problem. The use of UV stabilized plastic sheet would reduce the cost of solar dryers and may bring the solar dryers within the reach of farmers. The present study represents the design details and performance of UV stabilized plastic sheet covered dryer.

MATERIALS AND METHODS :

A solar dryer was designed depending upon thermodynamic analysis of the system including all heat, mass and humidity calculations and major parameters like quantity of air required, moisture removed from the product, rise and fall of air temperature and collector dimensions. The overall dimension is 220×212 cm. The constructional detail of the dryers is shown in Fig. 1. The castor wheels were provided to achieve transportability.

The dryer has the following main components.

(1) *Cabinet* : The frame of the dryer was made from $38 \times 38 \times 3$ mm and $25 \times 25 \times 3$ mm angle iron. The side walls were tapered in such a way that the front part of the cabinet was inclined at an angle of 25°. This inclination, which corresponds to latitude of testing station, ensures maximum availability of solar rediations. The whole cabinet was partitioned from the centre so that the length of trays can be reduced to half the total length of the cabinet for easier operation of trays. The underside of the cabinet was made with 24 SWG GI sheet on which mylar sheet was pasted to make it reflecting surface. The side walls were make with plywood with notches of the size of tray's width and height for pulling out the trays. The front surface of the cabinet was covered with 200 micron uv stabilized plastic sheet which served the purposes of transmitting all incoming solar radiations, reducing heat losses due to cross wind and reflecting back radiations from the mylar surfaces.

(2) *Trays* : The perforated trays each of 1.1 m length and 0.5m width were fabricated using $38 \times 38 \times 3$ mm angle iron. Wire mesh were provided on the bottom side of the trays which were attached to the trays through 25×3 mm M. S. flat. The trays were painted black with non-glazing blackboard paint. The handles were provided for easy handling of the trays. Rails of $25 \times 25 \times 3$ mm angle iron were provided for easy operations of trays.

(3) *Aspirator* : At the top, two chimneys of 1 m height and 15 cm dia each were provided for blowing out moist air. The chimneys were also painted black with non-glazing black board paint.

EXPERIMENTAL PROCEDURES :

The drying trails for dehydrating ginger were conducted in uv stabilized plastic sheet covered dryer. The hourly air temperature inside the dryer, ambient air temperature and radiations on plastic sheet were measured from 9.30 AM to 04.30 p.m. during the drying trials. The cleaned and peeled ginger was spread uniformly on trays. Total bulk weight of ginger was measured in morning and evening. The moisture contents of the ginger during each day were computed from difference in these weights.

RESULTS AND DISCUSSION ;

The temperature inside the uv stabilized plastic sheet covered dryer ranged from 34° to 55°C compared to ambient air temp. of 20°-30°C. The temperature inside dryer increased with increase of ambient air temperature. It was maximum somewhere between 11.30 and 12.30 hours. This trend was expacted also. The Table 1 gives detail of drying trial. From the Table 1 it is clear that the Moisture Content of ginger was reduced from 84 per cent (wet basis) to 10.06 per cent within five and half days.

The efficiency of utilization of solar energy (ratio of heat used in evaporation of moisture from ginger to the incident total solar radiations on uv stabilized plastic sheet) has been worked out by following relationship.

$$\eta = \frac{ML}{A \int_{0}^{\theta} H d\theta}$$

where η is the drying efficiency ; M, the mass of water removed from the drying material in the dryer ; L, the latent heat of vaporization of water ; A, area of absorber ; H, solar radiation on plastic sheet ; θ time during which solar radiations was measured. It was found that the average efficiency of utilization of solar energy was 15 percent in this dryer. The evaluation of the quality of random samples of dry ginger obtained from dryer was conducted for taste. aroma and texture, showed satisfactory quality of the product.

The drying requirements of different fruits and vegetables grown in rural areas is given in Table 2. The table shows that most of the fruits and vegetables require 50°—60°C temperature and direct type solar heating. Therefore, this dryer can be used for different perishable products.

COST ECONOMICS :

The main raw materials required for fabrication of this tray type solar cabinet dryer are—uv stabilized plastic sheet, angle irons, wiremesh, plywood. GI sheet etc, all of which except the uv stabilized plastic sheet are locally available in rural market. This sheet can be obtained from any office of Indian Petro-chemicals Ltd. The total cost of this unit was estimated Rs. 3000/-. The conventional annualized cost method comprising of fixed and variable cost was used for working out cost economics of ginger drying. The uv stabilized plastic sheet may deteriorate with time and may be less effective, therefore 1 percent of the initial investment (total cost 70 Rs.) is used for replacing the sheet. The cost economic calculation shows the cost of drying ginger is Rs. 0.86 per kg and with 180 days utilization in one year, the pay back period is 5 years and 11 months. The economics also reveal the net profit of Rs. 100 per day in drying of ginger with tray type uv stabilized plastic sheet covered solar cabinet dryer.

CONCLUSION :

The following specific conclusions may be drawn by this study :

(1) The uv stabilized plastic sheet covered dryer was 40% lighter and 30% cheaper than glass covered solar dryer,

(2) The tray type uv stabilized plastic sheet covered solar cabinet dryer is suitable for dehydrating fruits and vegetables within 5—6 days even in cold winters.

(3) The developed dryer is capable for producing drying temperature of 50°—60°C, which is optimum for dehydration of most of the fruits and vegetables grown in rural areas. Therefore this dryer is promising for it adoption in rural areas for dehydrating cash crops to earn more net profit.

Table 1 : Detail of drying trials of ginger in uv stabilized plastic sheet cover solar cabinet dryer.

Initial moisture content = 84%

Date Dec. '90	Radiation on uv sheet (K cal/m² day)	Moisture content (%)
20	6020	76.4
21	6600	65.2
22	5450	45.5
23	5265	31.3
24	5660	15.6
25 (upto 1230)	4030	10.1

Table 2 : Drying Requirements of Agricultural and Food Products.

S. No.	Product	Type of solar drying	Temperature requirement (°C)	Initial moisture content (%) (W. b)	Final moisture content % (W. b)
1.	Peas	Direct	60° (Solar)	25	5
2.	Garlic	Direct	43–48° (Solar)	70–80	6.5
3.	Fish	Direct	50° (Solar)	65.75	16
4.	Grapes	Direct	60° (Solar)	83.5	10–16
5.	Beans (baked)	Direct	60° (Solar)	10–26	3–4
6.	Beans (green)	Direct	65° (Solar)	10–20	5
7.	Chillies	Direct	60° (Solar)	70–80	10
8.	Ginger	Direct	60° (Solar)	80–85	13–15
9.	Turmeric	Direct	60–70° (Solar)	80–85	13–15
10.	Copra	Direct	40° (Solar)	45–50	6
11.	Shelled maize (Yellow)	Direct	45° (Solar)	20–25	9.5
12.	Shelled Maize (White)	Direct	45° (Solar)	20–25	10
13.	Paddy	Direct	60° (Solar)	20–25	10
14.	Milled Rice	Direct	60° (Solar)	15.5	9
15.	Wheet (Grain)	Direct	45° (Solar)	15	10
16.	Jawar	Direct	45° (Solar)	20–25	10
17.	Ground nut shelled	Direct	45° (Solar)	40–60	9
18.	Mustard	Direct	45° (Solar)	20–30	9
19.	Soyabeen	Direct	45° (Solar)	20–30	7.5

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S.N.	COMPONENT	MATERIAL
1	CASTER WHEEL	
2	COLLECTOR	GLASS OR UV STABILIZED PLASTIC SHEET.
3	REFLECTOR	MYLAR.
4	TRAY	ANGLE IRON & WIRE MESH
5	CHIMNEY	G.I. SHEET.
6	FRAME	M.S. ANGLE IRON

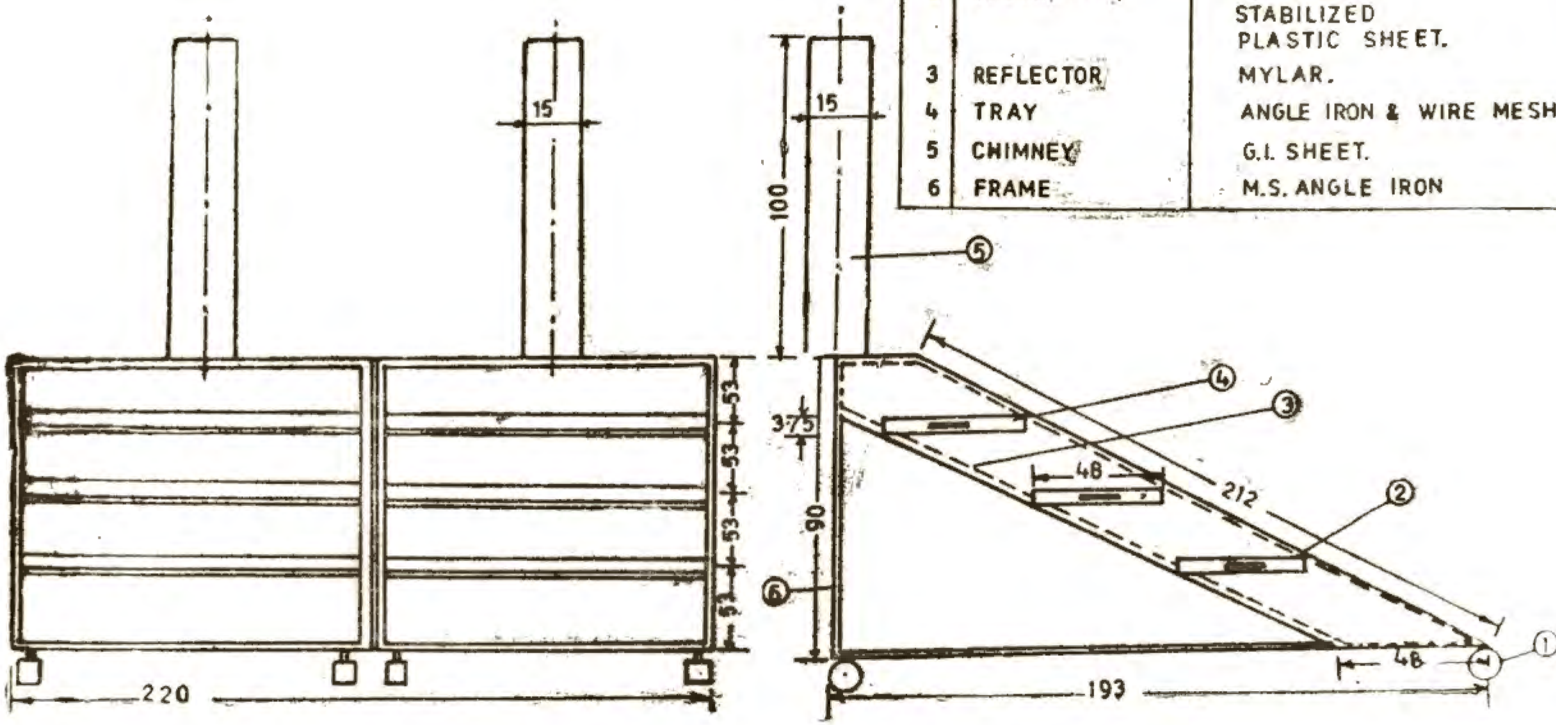

FIG. 1 SOLAR CABINET DRYER

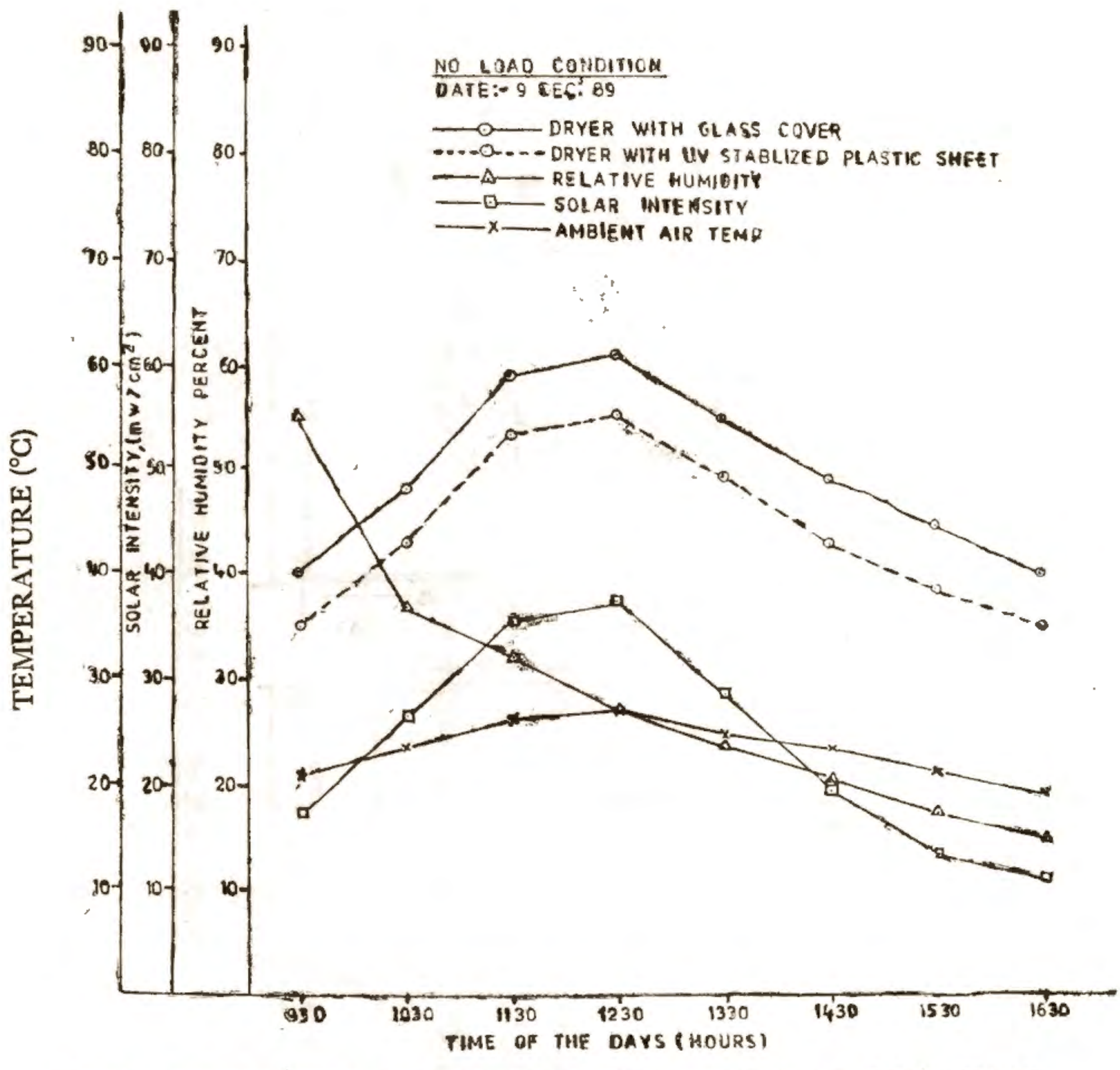

FIG 2 TEMPERATURE RISE IN DRYER WITH AMBIENT AIR TEMP. SOLAR INTENSITY AND RELATIVE HUMIDITY.

EFFECT OF TEMPERATURE ON BIOGAS PRODUCTION FROM WATER-HYACINTH

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Anaerobic digestion of water hyacinth (Echhnornia crassipes) carried out at different temperature range (30-39°C) and hydraulic retention period (0-35 days). The gas production increased sharply as the temperature were raised above 30°C and maximum yield was observed at 37°C, rather than 35°C, but production reduced after 37°C. In this paper, the effect of temperature on biogas production from water hyacinth is highlighted.

INTRODUCTION

Production of biogas from water hyacinth by anaerobic digestion is affected by several physical as well as chemical factors like pH, temperature, concentration of volatile acid, minerals and metals etc.[1-4]. Temperature is one of the most important factor, which influences the rate of biogas production. It has been reported that mesophilic methanogenic bacteria are much sensitive at temperature between 35-40°C, but it is also observed that, generally maximum gas production is obtained at temperature 35°C. It is well known that the rate of gas production decreases considerably at temperature, below and above the optimum temperature [5,6].

Person et al[7] and Roediger[8] have reported that maximum gas production occurs in the mesophilic temperature range (30-40°C) at 35°C. This view was also supported by Cowley and Waste[9]. Ghosh et al.[10] have found the optimum digestion temperature is usually near about 35-37°C. Joubert et al[11] working at temperature range in between 35°C to 37°C and found that the later temperature gave better biogas production as well as methane yield. Bansal[12], Ficher et al[13] and Mills[14] have reported that the rate of gas production doubles up for every 10°C rise in temperature between 15°C to 36°C for mesophilic bacteria and similarily just doubles up between 37°-56°C for thermophilic bacteria.

In the present literature none of the authors have expressed optimum temperature for biogas production from water hyacinth. Considering the above observations, the authors are promoted to select optimum temperature for maximum production of biogas as well as methane content from water hyacinth.

EXPERIMENTAL

(1) Chemical Analysis of Water Hyacinth :

Total volatile solid (TVS) were estimated by the combustion of known quantities of the dry sample at 420°C in muffle furnace to the constant weight. Lignin content and total kjeldahl nitrogen were estimated spectrophotometrically. Total organic carbon was determined volumetrically by the Piper method. Metals were analysed by pulse polarograph.

(2) Anaerobic Digestion of Water hyacinth :

The sample of water hyacinth was washed clearly with water and Na_2 EDTA to remove dust, clay particles and sands etc. After wiping the sample were dried at 110°C in oven to constant weights. Now 100 gm of biomass (dry, water hyacinth) alongwith water was taken into thermostat air tight ceramic digester of 1 litre capacity, attached with sampling and measuring units (Fig. 1). The methane content of biogas was determined using orsat apparattus.

RESULTS & DISCUSSION

The chemical composition of water-hyacinth was found as represented in Table-I.

TABLE--I

Components	Percentage %
Moisture	92.37%
Total Solid (TS)	7.63%
Total Volatile Solid (TVS)	12%
Kjeldahl nitrogen	1.9%
Carbon	36%
Lignin	8-10%
Cellulose	40%
Oxalate	2%
C/N ratio	19%
Metals	Ca, Zn, Mg, Na & K present.

A typical sets of observations regarding with the biogas production from water hyacinth at different temperature (i. e. 30, 33, 35, 37 & 39°C) and hydraulic retention time (0-30 days) were presented in Table II.

TABLE—II

Hydraulic Retention Period=35 days

Hydraulic retention period (in days)	Production of Biogas from Water hyacinth (in Lkg^{-1}) dry weight, at different temperature (in °C)				
	30°C	33°C	35°C	37°C	39°C
5	6	9	50	69	47
10	7	25	101	137	98
15	10	54	148	215	139
20	21	77	196	275	190
25	29	90	215	301	213
30	42	111	247	358	241
35	55	125	290	415	282

The rise in temperature increases biogas yield from water hyacinth as summarised in Table-III.

TABLE-III

Increase in Temperature in °C	Effect on gasproduction
30 to 33	3 times higher
30 to 35	7 times higher
30 to 37	10 times higher
30 to 39	7 time higher

The average biogas yields at temperature 30°C and 33°C in 35 days were 4.85 and 14.31 kg^{-1} biomass respectively. The yield increased sharply at 35°C (35.6 L kg^{-1}) and 37°C (50.5 L kg^{-1}). The yield at 37°C was nearly ten times that obtained at 30°C. Further on increasing the temperature of digester i. e. 39°C, yield again decrease i. e. 34.7 L kg^{-1}.

The impact of temperature on biogas production is clearly understood from Table-II. It indicates that from 30 to 33°C, yield increased four times and from 30-35°C and 30-37°C, increased 7 and 10 times respectively. But after 37°C, further fall in yield showed that this temperature (37°C) is optimum for biogas production especially for water hyacinth.

Following results have been concluded from Fig. 2.

(1) It indicates that biogas production at 30°C is negligible upto 20th days of hydraulic retention period (HRP), and after 20th day, graph moves onward. But at 33°C. production is very low up to 10th days, after this it further increased. A higher temperature i. e. 35°C and 37°C, this initial fall was not seen. Maximum gas production was observed at 37°C.

(2) Thus, it indicates that at low temperature (30°C) the methanogenic bacteria takes about 20 days for activation, but at higher temperature it is activated earlier within five days.

(3) From figure-2, it is also clear that on increasing temperature from 30-37°C, gas production increases, but again above 37°C, yield decreased. It clearly shows that the temperature i. e. 37°C is optimum for biogas production from water hyacinth (50L kg^{-1} biomass dry weight).

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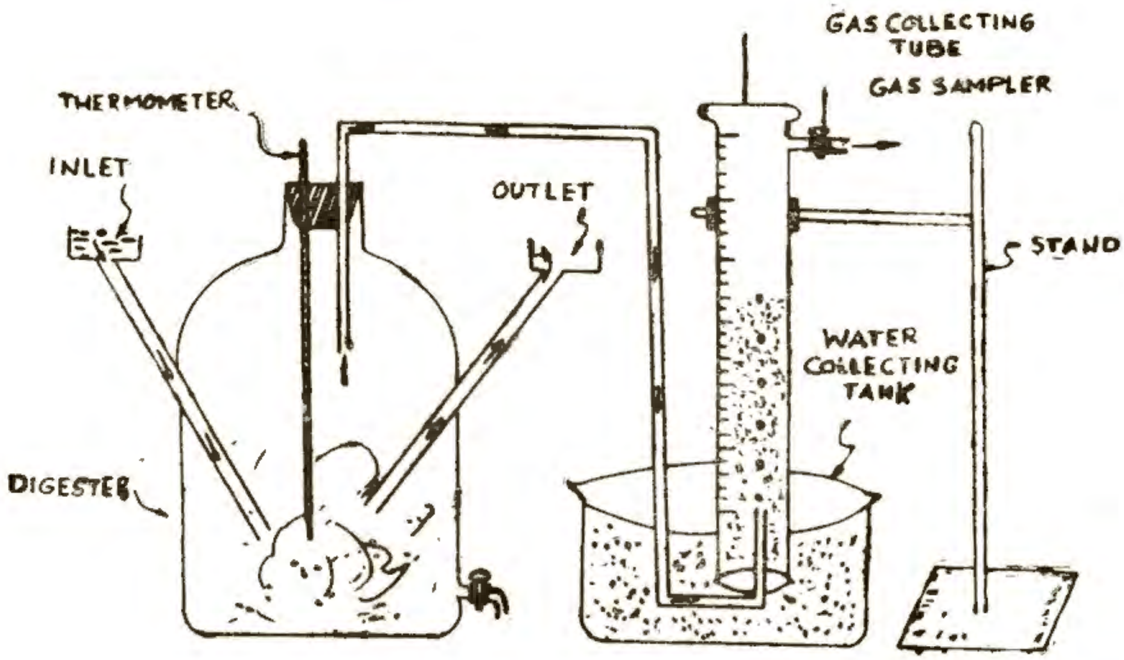
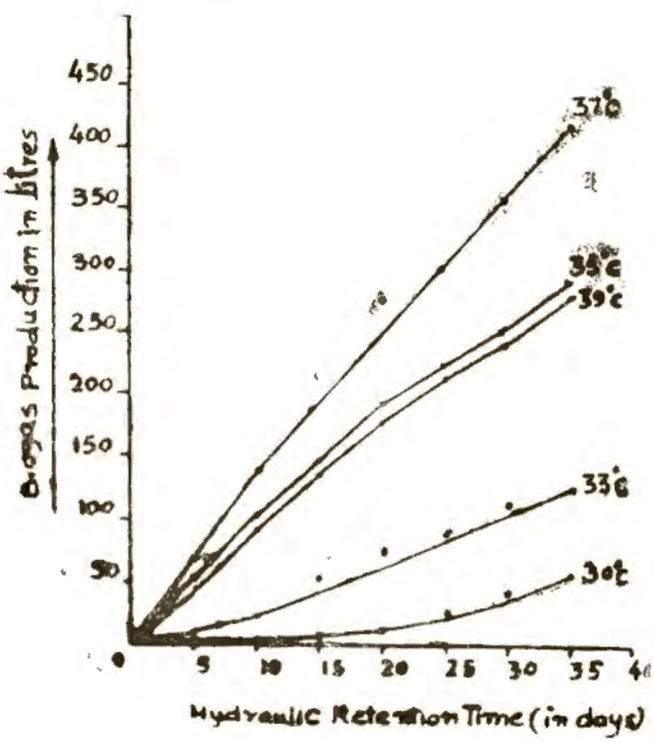


FIG. 1. Diagrammatic Representation of Digester Assembly



INK MAKING

Ink is not only being used for writing but also being used for printing. Ink can be classified in two categories :—

1. Writing Ink
2. Printing Ink

Writing Ink is soluble in water while printing ink is insoluble in water. Writing Inks can be further subdivided in different categories.

1. Iron Tannin Ink
2. Coloured Inks
3. Carbon Ink prepared from lamp black.

IRON TANNIN INKS :

Under such category fountain pen inks, Bank's permanent inks are included. Tannin is obtained from different Vanaspati. Apart from this colour, Gum are also the constituent of such type of inks.

COLOURED INKS :

Colours, Gums are the main constituent of coloured inks. These inks are cheap and available early sold in the market but these are not of permanent type.

CARBON INK PREPARED FROM LAMP BLACK :

It was used in quite old days but coloured inks are used these days.

PRINTING INKS :

Printing Inks are used for printing of documents, books etc. Turpentine oil, Solvent oils are used as thinner for printing inks.

TYPES OF WRITING INKS :

Blue or red inks which are often used by students falls under this category. These are mixture of colour ; solvent and water. Gum is used for achieving viscosity.

FOUNTAIN PEN INK :

The solid content is comparatively lesser than writing ink, According to chemical composition, coloured and iron tanning Compound Inks are of two types.

IRON TANNING COMP . UND INKS :

These inks are available in Blue and in other colours also. The colour of inks appears as to the colours used in preparation of inks later on the colours terns to black. These are of permanent in nature these are not washable and are not affected by light and humidity.

COLOURED INKS :

These are available in Red. Voilet, Green, Royal Blue Colours which can be washable. These are not good from the point of permanency but it is very commonly used due to attraction.

METHOD OF PREPARATION OF FOUNTAIN PEN INK :

MATERIAL REQUIRED :

Gallic Acid (Dilute) pure	12 gms
Tannic Acid (Dilute) pure	38 gms
Gum Arabic	13 gms
Ferrous Sulphate Crystalline	45 gms
Ink Blue A. S. (ICI)	20 gms
Hydrochloric Acid (Conc.)	40 c. c.
Glycerine	5 c. c.
Phenol	5 gms
Distilled Water	4.5 liters
Glass plate	2 nos
Beaker	4 nos
Plastic Bucket	1 no

METHOD OF PREPARATION :

1. Take Distilled water (4.5 litres) in a plastic bucket. Divide it into three equal parts.

2. Dissolve Gallic and (12 gms). Tannic acid (38 gms) and Gum Arabic (13 gms) in 1.5 litres of distilled water. If necessary then heat the water so that all the contents are completely dissolved.

Distilled water in plastic bucket   1.5 litres Distilled water in beaker

Fig —1

Fig. 2 (c) Add Gum Arabic

Fig. 2 (d) Solution no. 1 is ready

3. Add glycerine to it and allow to cool, then add hydrochloric acid to it. This is Solution no. 1.

Fig. 3 Add Glycerine

4. Dissolve Ferrous Sulphate in 1½ litre of distilled water in another breaker. If necessary heat it so that ferrous sulphate is easlly dissolved. This is solution no. 2.

Fig. 2 (a) Add Gallic Acid

Fig. 2 (b) Add Tannic Acid

Fig. 4 (a) Take distilled water in another beaker

Fig. 4 (b) Add Ferrous sulphate in water

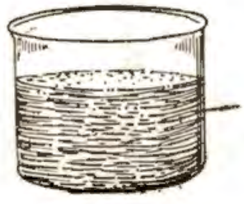


Fig. 4 (c)
Solution no 2 is ready

5. Take one and half litre distilled water in another pot and heat it and dissolve colour ink blue in water. This is solution no. 3.

Fig. 5 (a) Take distilled water in beaker

Fig 5 (b) Dissolve Colour Ink Blue

Fig. 5 (c) Ink Blue in hot water

Fig. 5 (d) Solution no 3

6. **Take a big container pour solution no. 1. Add solution no. 2 to it gradually and stir it. Add solution no. 3 to rest of the solutions.**

Fig. 6 (a) Add Solution no 2 to Solution no 3

Fig 6 (b) Solution no 3 ready

7. Add Phenol to a portion of ink and stir with the help of wooden stick. Leave the solution for about a month.

Fig 7 Add Phenol

8. Precipitate will be formed after one month. If the ink is left for more than a month then it will be better.

9. Decant the prepared ink.

10. Pack ink in bottles.

Ink is ready

PREPARATION OF ROYAL BLUE INKS

MATERIAL REQUIRED :

Methylene	28.5 gm
Glycerine	5 ml
Phenol	5 ml
Distilled Water	4.5 litres
Glass pots	4 nos.
Gum Arabic	28.5 gm
Acetone	25 ml/litre
Ethylene Glycol	25 ml/litre

METHOD OF PREPARATION :

1. Dissolve Gum Arabic in a litre of distilled water. Warm if necessary.

Fig. 1 (A)
Mix Ink Blue A.S.

Fig. 1 (b)
Glycerine

Fig. 1 (c)
Gum Arabic

2. Mix Glycerine to it.
3. This is solution no. 1.
4. Dissolve Methylene blue in distilled water this is. solution no. 2.
5. Pour slowly solution no. 1 to solution no. 2 with constant stirring.
6. Take small quntity of solution in a beaker and dissolve phenol in it.
7. Filter ink through filter paper.
8. Add ethylene glycol and acetone the filter ink.
9. Pack the ink in glass bottle.

PREPARATION OF RED FOUNTAIN PEN INK :

MATERIAL REQUIRED :

Acetone	25 ml
Brilliant Crosene Scarlet	20 gms
Gum Arabic	15 gms
Glycerine	5 ml
Phenol	1 gm
Distilled water	1 litre
Ethylene glycol	25 ml

METHOD OF PREPARATION :

1. Dissolve gum arabic (15 gms) in distilled water. Heat if necessary.
2. Take small quantity of this solution and add Phenol to it.
3. Add the solution to the whole Solution.
4. Stir continuously the solution with glass rod or wooden stick.
5. Ink is filtered in through filter paper.
6. Add 25 ml acetone to the filtered ink.
7. Add 25 ml Ethylene glycol to the ink.
8. Ink is packed in bottles.

PREPARATION OF STAMP PAD INK

INGRADIENTS :

Glycerine	5 ml
Distilled water	4.5 litre
Methyl Voilet	300 gms
Glass tub	one

PREPARATION :

1. Mix glycerine to distilled water.
2. Add Methyl voilet is added in this mixture and leave for over night.
3. Stir and mix thoroughly.
4. Pack in glass bottles.

TABLET AND POWDERED INK :

Inks can be prepared in tablet forms. It can be easily prepared as ink powder.

PROBLEMS IN FOUNTAIN PEN INK PREPARATION, REASON & SOLUTION :

Problems	Reason	Solution
1. Precipitation	*Reduction in quantity of acid*	
	1. By using less quantity of acid	Use right quantity of acids
	2. Defects in glass of bottles	Do not use bottles made out of alkaline glass
	3. Incorrect proportion of Iron Tannic Compound	Use right proportion of Iron tannic compounds
	4. Fungus effect	Use right quantity of phenol and salicylic acid in preparation of ink.
2. Corrosion effect on nib.	Excess quantity of acid	Use necessary quantity of ink.
3. Deposition of ink on nib	Presence of excess solid content in ink	Prepare right quantity mixture. Use glycerine for correct flow of ink,
4. Delayed drying of ink	(a) presence of excess Glycerine/ Dextrine	Use correct mixture of material.
	(b) absence of acetone & other solvents	
5. Abnormal smell	Right quality of gum tannic acid	Use methyl salicylate.

FUEL BRIQUETTES FROM DRY LEAVES AND AGROWASTES

Agricultural wastes, Secondary biomass materials like cotton, corn cobs, plant stalks, groundnut shell, coconut shell, many other unutilized plant stems, dry leaves etc. can be converted into fuel through controlled burning or pyrolysis. The fuel has high calorific value, low ash content, smoke comes out, cost of production is low as compared to the cost of wood charcoal. The fuel is converted into briquettes which are easily transported from one place to other. The conversion of dry leaves/agrowaste to fuel briquettes takes place by pyrolysis and the equipment in which this process takes place is known as pyroliser.

Pyrolysis is a process in which the waste products are heated to a high temperature in the absence of air or Oxygen to produce charcoal. In this process the restricted amount of air is introduced for the pyrolysis of agrowaste or forestry waste.

CONSTRUCTIONAL DETAILS OF PYROLYSER

It consists of a 200 litre cylindrical vessel supported over a 3 legged stand. The vessel is provided with a conical grate at the bottom. The grate is made from 2.5 mm thick mild steel plate with 15 mm dia perforation at the bottom of the drum in the centre there is a 50 mm dia G. I. pipe piece (15 cm height and 5 cm dia) as shown in Fig.-1 and Fig.-2.

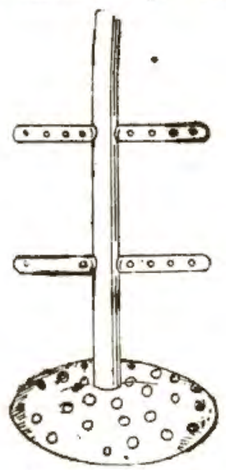


Fig. 1—Grate

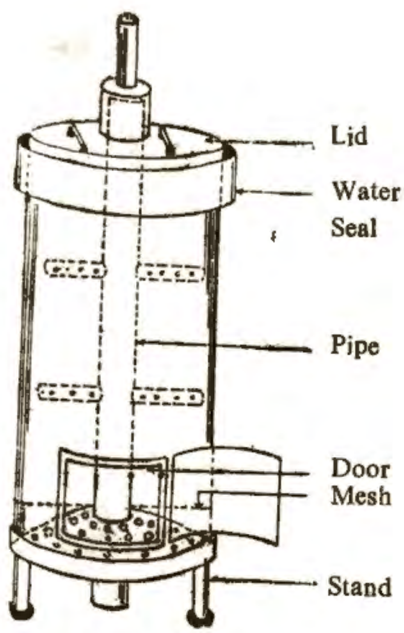


Fig. 2—Pyrolyser

Net of G. I. wire is welded at about 12 cm height at the top of grate. The grate is also provided with a central chimney 7.5 cm dia having four perforated steel pipes (2.5 cm dia) two on either sides of chimney. Perforation is done vertically and horizontally on the pipe.

This arrangement in the central chimney provides smooth flow of hot gases as well as it provides little air in the pyroliser. The hinge door (20× 20 cm) is provided at the lower end of drum. Charcoal formed can be taken out from this door. The drum has a lid having circular box (15 cm height and 10 cm dia with an outlet of G.I. pipe (15 cm height and 2.5 cm dia). The drum has arrangement for sealing the drum and top cover (lid) with water.

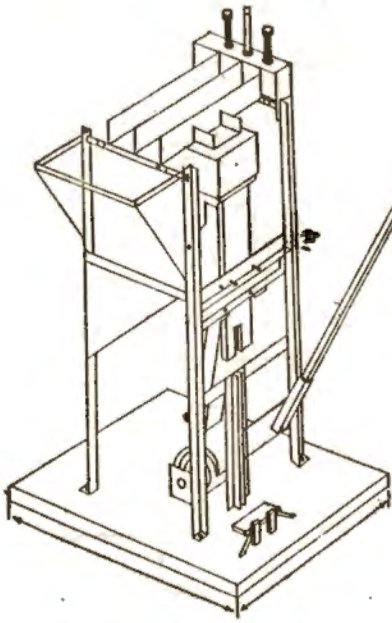


Fig. 3—Briquetting Machine

CONSTRUCTIONAL DETAILS OF GRINDER (ROLLER) :

The roller is made of G.I. pipe 60 cm in length and 10 cm dia. The weight of roller is about 25/30 kg. The roller is provided with an iron handle total length 1.25 meters. The roller can be easily rolled on flat smooth surface.

DETAILS OF BRIQUETTING TOOL AND BRIQUETTING : BRIQUETTING TOOL :

It consist of two G.I. pipes no. 1 and 2, pipe no. 1 is open at both the ends and the upper end is provided with two handles. Pipe no. 2 is closed from both ends with welded iron plates. The length of pipes are 15 to 20 cm. The diameter of pipes are 4 to 5 cm respectively. Pipe no. 2 can be easily inserted in pipe no. 1.

BRIQUETTING MACHINE :

The machine has a body frame made of angle iron supported on a base plate which can be grouted. The upper portion of the body contains a box where a suitable FRP (Fibre reinforced plastic) dia of desirable briquette size can be mounted can be covered by lid having suitable locking device operated by handles. The lower portion consist of a punch suitable to die mounted on the machine. The punch is operated by lower lever. The force is transmitted to the punch with the help of the crank and a connecting rod and connected with hand operated lever at the bottom (See Fig.-4).

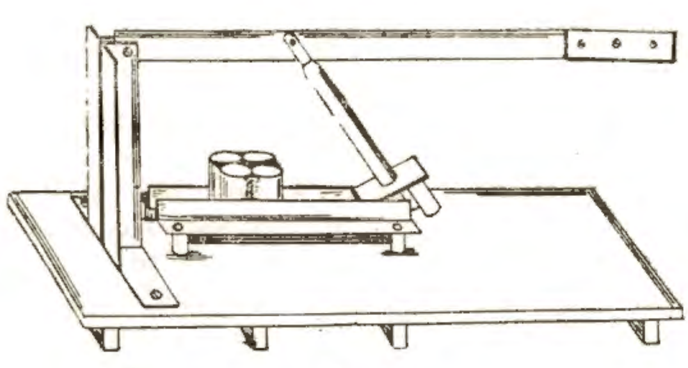


Fig. 4

PREPARATION OF PYROLYSED BRIQUETTES FROM BIOMASS :

Pyrolysed fuel briquettes from biomass are prepared through following four steps :—

1. Pyrolysis
2. Pulverisation
3. Mixing of binder
4. Briquetting

PYROLYSIS :

(1) The 40–45 kg (approx.) of dried biomass with moisture content 15–20% is cut to pieces of 15 to 20 cm length.

Fig 7—Cutting of leaves/branches

Fig. 5—Dry Branches

Fig. 6—Dry Leaves

(2) Drum is completely filled with portion of dried leaves etc. keeping door open.

Fig. 8— Branches/leaves being filled in pyrolyser

(3) The biomass (agrowaste) is set to fire through the door. The door is closed and door spaces are sealed with mud keeping the air inlet pipe of drum open.

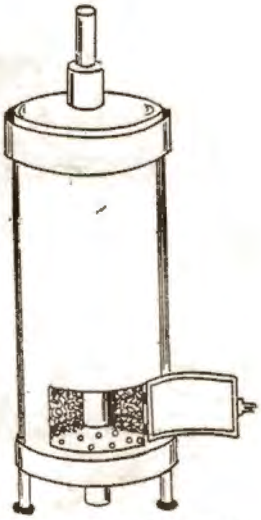
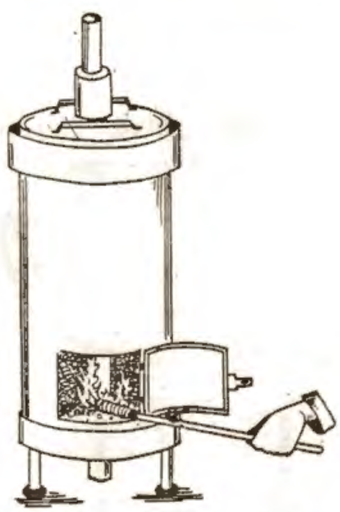


Fig. 9—Fire door open



Fig, 10—Firing of biomass

(4) A thick blackish smoke comes out but after few minutes biomass starts burning with flame. Another portion of biomass is immediately put in the pyroliser till the flame subsides.

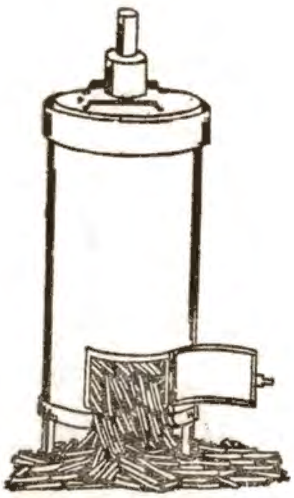
(5) Again thick smoke comes out and after few minutes biomass starts burning with flame. Again another portion of fresh biomass is added in the pyroliser so that the flame may again subsides.

(6) This process is repeated till whole of biomass (40/45 kg) is put into the pyroliser.

(7) The lid is now sealed with water.

(8 A thick smoke comes out of the gas outled made on the lid. After some time the colour of smoke changes to bluish white and the air inlet pipe is sealed with water in a mud and the gas outlet is also sealed with mud.

(9) The pyroliser is allowed to cool and when the pyroliser is completely cooled the door is opened and the charcoal formed is taken out.



Fig, 11—Burnt charcoal being taken out

PULVERISATION OF CHARCOAL :

(1) Charcoal is spread on the smooth surface of ground.

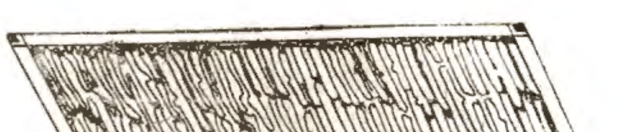


Fig. 12—Spread Charcoal

(2) The roller is rolled on the charcoal several times.

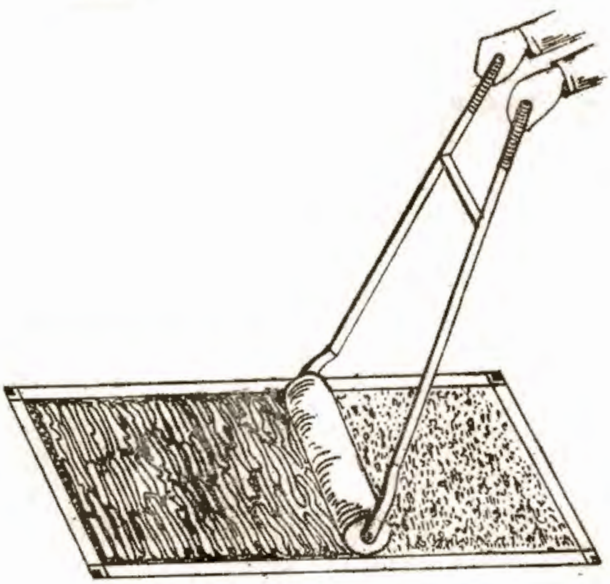


Fig. 13—Grinding of charcoal

(3) The charcoal powder is sieved through a fine sieve to remove bigger particles of charcoal.

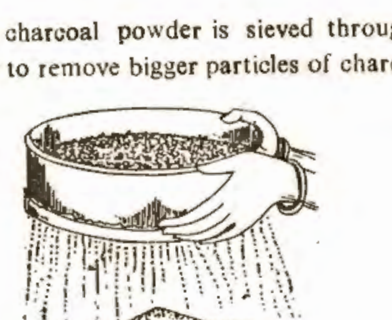


Fig 14—Sieving the charcoal

(4) The big charcoal particles are again made to powder as previously done.

MIXING OF BINDER TO CHARCOAL POWDER :

(1) Fine clay of about 5% by the weight of charcoal powder is poured into the water (25% by weight of charcoal powder) and left for 24 hours.

(2) The foamy or creamy layer is removed from the surface of water and mixture is stirred and filtered by cotton cloth so that there should be no traces of foreign materials are left.

(3) Charcoal powder is taken into tub and molasses 10% by weight of charcoal powder is mixed to it.

(4) Fine clay mixture in water is added to bit by bit in the charcoal and mixed well. This mixture is stirred well to have a homogeneous mixture.

This homogeneous moistened mass is made to briquettes with the help of briquetting tool or briquetting machine as follows :

(a) BRIQUETTING TOOL :

(1) The moistened homogeneous charcoal with molasses is filled in pipe no 1 and pipe no. 2 is inserted into it.

(2) These pipe are held vertically keeping handle side up and a below is given with the help of hammer on pipe no. 2.

(3) The position of briquetting tool is now reversed and a slight pat is given on pipe no. 2 to briquette out in the form of a cylinder.

(4) The cylindrical briquette is out into sizes and dried into sun.

(b) BRIQUETTING MACHINE :

(1) Die Box is opened and filled with moistened charcoal mixed with molasses.

(2) The box is closed with the lid and looped with self locking devices.

(3) A pressure is exerted on the punch with connecting rod for compact charcoal in die box.

(4) Cover is opened and a very little pressure is given on punch with the connecting rod. Briquettes are taken out and are dried in the sun.

PRECAUTIONS :

(1) Person should use gas mask during pyrolysis and briquetting.

(2) Quantity of water should not be more added to to the charcoal then specified weight.

(3) Pyrolyser should be installed away from the thatched houses dried grains, agrowastes etc.

(4) Door of pyrolyser should be opened when the pyrolyser is completely cooled off.

Fig. 15—Pyrolyser should be away from thatched house.

HARNESSING SOLAR ENERGY

A less expensive way of concentrating and collecting Solar energy is suggested here. Round bottomed flasks, with as nearly spherical shape as possible, with a long and narrow neck, made from clear glass are taken and filled with clear water. These are placed on a plate or sheet, with holes suitably spaced so as to leave minimum area between flasks, which in turn is supported by a rigid frame work. When spherical lenses are used, the focus follows a definite route from west to east. If this focus of sun's energy is collected by a suitable flat topped tube having water or any liquid to be heated, and the width of the tube at the top is sufficiently wide, then north south shift of these tubes would be needed only say once a week, and it would not be difficult to provide such movement on a section to section basis of the proposed waterlens farm.

Due to the improper shape of the flask, there might be a distortion in the focus, adding to lower efficiencies. By proper manufacture, this could be taken care, rather than making a spherical lens entirely out of optical glass, which also should be cheaper and definitely more efficient than the systems presently developed.

If proper facilities are provided, I can undertake this development and demonstrate its usefulness, in a short period, provided all facilities are extended.

VEGETABLE DEHYDRATOR FOR VILLAGES

Scientists in Bhopal have designed an electrically-operated dehydrator which can dry about 50 kilograms of vegetables daily in rural areas.

India produces about 735 million tonnes of vegetables every year, of which 30 percent is estimated to be lost during various stages of post-harvest operations. These losses are mainly due to lack of infrastructure for handling, storage and processing at the rural level.

Being perishable by nature, vegetables start detriorating soon after harvesting or picking. Sun drying has been used since ancient times for better preservation, but the process is unhygienic and long.

The new dehydrator developed at the Central Institute of Agricultural Engineering (CIAE), Bhopal, basically consists of a drying chamber, a plenum chamber, a heating chamber and a blowing unit. The drying chamber has 20 trays made of nylon wire mesh for laying out the product to be dried.

The vegetables are "prepared" by washing, peeling and cutting or slicing. The prepared material is blanched and sulphited if required, and spread over the drying trays.

It is dried by switching on a blower and a heater for 11-14 hours.

Reporting the details of the dehydrator in the journal *Invention Intelligence*. CIAE scientist K. K. Singh said it was tested for processing cauliflower, cabbage and onion flakes.

The total cost of production of the dehydrator is around Rs. 12,000 and the cost of operation works out to a mere Rs. 1.20 per kg of raw material.

The machine can be used for dehydrating surplus vegetables produced in rural areas, thereby reducing wastage and providing better income and employment opportunities to vegetable growers, Dr. Singh says.

GREEN REVOLUTION WITH EARTHWORM

A novel experiment of bringing about green revolution without using any chemical fertiliser has produced astonishing results in Maharashtra, claims the noted educationist and scientist, Prof. M. R. Bhiday. The experiment, which has been a success in western Maharashtra, will now be tried in Nagpur and Katol, he said.

Prof. Bhiday, who was here recently, told PTI that this new experiment in agro-ecology involves the use of earthworm as biological agent to fertilise the soil.

A fellow of the Maharashtra Academy of Science and the Indian National Academy of Engineers, Prof. Bhiday has been carrying out this research for the last 10 years under the auspices of MAS and his results have been presented in several international symposia.

The experiment involves breeding a large number of earthworms in specially constructed containers and then using their vermi compost to fertilise soil.

Prof. Bhiday said the containers are nothing but wooden crates filled with bio-degradable wastes such as cowdung, rotten leaves and other organic material. Conditions are created which are conducive to the earthworms to breed rapidly and produce vermi compost, which contains earthworm casts and eggs that make the soil extremely fertile by providing it with micro organisms and nutrients essential for plant growth.

The technology is so cost-effective that just 2000 earthworms could produce the equivalent of one tonne of fertiliser per month Besides, they increase the soil's water retention capacity.

The experiment has been tried in Maharashtra right from the western coast to the eastern end and the results have been highly encouraging, especially in Ratnagiri, Pune and Nasik.

This technology, if properly developed, would prove to be a boon for the small farmers as well as other villagers who can start "wormeries" for mass breeding of earthworms and sell them to cultivators. "Adoption of earthworm technology would also stop indiscriminate use of chemical fertilisers, which in the long run, do considerable damage to the soil".

LEATHER SPLITTING AND PROFILE CUTTING MACHINE

K. L. E. Society's Engineering College, Belgaum. Skin or hides of a great number of creatures are tanned and processed variously to make leather used in many different articles ranging from footwear to highly fashionable accessories-essential features of civilised lifestyles.

Leather industry in India, one among the oldest, is spread in both organised and unorganised sectors. The leather, before it can be shaped to the desired final form such as a shoe or a vanity bag, has to undergo a number of operations. To accomplish these operations, the industry employs a variety of machines such as the width shaving machine, the inclined blazing machine, the setting machine, the stacking machine and the buffing machine.

Industries in the small sector find it difficult to own all these different machines. They would be delighted if a single machine, combining a number of operations were available. Sensing this need a machine to perform the operations of splitting, profile cutting, design embossing and pressing was designed and fabricated.

Basically the machine has two mild steel rollers with adjustable clearance between them using which leather of various thicknesses can be rolled or pressed. A splitting knife can be employed behind the rollers to cut the leather. Attachments for profile cutting and design embossing can be added onto the main roller shafts. This simple machine can be manufactured easily in an ordinary workshop and needs very little maintenance.

Being simple in design, easy to manufacture and operate and requiring little maintenance, machine is ideal for cottage level leather processing industries It is estimated to cost around Rs. 2000/-. The productivity of the machine could be enhanced by an electric drive.

"HIMSHAKT" — STONE BIOGAS PLANT FOR THE HILLS

A new type of biogas plant developed for the hills promises to be cheaper, easier to construct and more efficient than the ones currently in use.

An added advantage is that it can be made of stone which is available in plenty in the hills and so can be constructed easily by local people.

The new Himshakti biogas plant has been developed by the Regional Biogas Research and Development Centre at the Himachal Pradesh Krishi Vishwavidyalaya, Palampur.

It is 20 percent cheaper and produces 12 percent more gas daily compared to the Janata and Deen Bandhu plants currently in use in the Himachal hills.

In hilly regions like Himachal, the major problems faced while installing biogas plants include the high transportation cost of the construction material (bricks cost as high as Rs 1250 per thousand) and difficulties in excavation of a pit for the plant.

These cause the cost of installation to run so high that they adversely affect the biogas plant implementation programme in the hills.

Besides, it is difficult to make roundish excavations by cutting stone for the spherical foundation of the Janata biogas plants.

The new Himshakti design allows the digester to have a bigger diameter, without compensating on its strength, as a minimum wall thickness of 2.30 mm is possible with stone construction compared to 115 mm thickness which can be obtained with bricks.

The height : diameter ratio too has been lowered to a factor of 0.66 from 0.83 and the radius of the dome top of the plant is so selected that there is no need to construct an additional pillar at the centre of the plant.

A three-cubic-meters Himshakti plant is 30 percent cheaper when constructed with bricks and 20 percent cheaper with brick stone masonry.

The plant produces an average of 2.4 cubic metres of biogas daily when fed with 60 kg of raw material compared to 2.15 cubic meters of biogas obtained from the Janta plant now in extension in the hills.

Himshakti was developed under a project sponsored by the Indian Council of Agricultural Research (ICAR) under its All India Coordinated project on Renewable Energy Sources for Agricultural and Agrobased Industries.

SOLAR PONDS

One of the several methods of utilising solar energy is to construct a solar pond. At the Indian Institute of Science, a solar pond of size 240 m^2 has been built to study and monitor the performance of solar ponds. From the experience gained by this study it was decided to construct a demonstration solar pond at Masur, a village in Uttara Kannada.

Solar pond is a large body of water used for collection and storage of solar energy. In any natural pond where the water is transparent, about 30% of the solar radiation reaches the bottom and water there gets hotter. Water when heated becomes lighter and rises, thereby mixing with the cooler water in the rest of the pond. Hence the temperature of a natural pond almost never rises significantly above the ambient. However, if we can devise a means by which the layer of water at the bottom is prevented from mixing with the rest, then the temperature at the bottom can rise as high as 95°C. Mechanical barriers like plastic/glass sheets have been thought of but have proved impractical for large ponds. The earliest and least expensive method is the use of common salt. If sufficient amount of common salt is added to the water near the bottom, then this salty layer will always be at a higher density than the layers above. There will, therefore, be no intermixing of layers. A pond which utilises this concept is called a salinity-gradient solar pond. Such natural salinity-gradient solar ponds were first discovered in Romania in 1902.

However, man made solar ponds were first studied in Israel about 25 years back. In its simplicity, soil is dug from a predetermined area to a depth of about 2.5 meters. A plastic liner or, better still, 2 or 3 layers of liners of 1/4 mm thick low density polyethylene sheets are laid in the dug out pond and heat sealed. To prevent the liners being damaged by ultra-voilet radiation, they are buried by dumping some soil or placing some tiles on them. Now water and common salt are added. In a typical solar pond, about half a tonne of common salt is added for each square metre area of the pond, The water and salt are mixed till a density close to 1.2 gm/cc is reached. Pure water is then carefully poured at different places until the ponds in complete. Thus 3 layers are created, viz., a bottom storage layer of 1 metre thickness a top layer of 50 cm thickness and the sandwiched layer of 1 metre thickness. The salinity of the middle layer increases linearly with depth. This important and essential layer is called a non-convective layer and prevent the mixing of the bottom and top layers This layer is also critical in that if it is too thin, a lot of heat is lost to the top layer while if it is too thick sufficient solar radiation does not reach the bottom or "storage" layer. After the establishment of the three layers or zones it takes about 2 months for the temperature of the bottom layer to increase by 40°C—50°C.

The largest solar pond ever constructed is the Israeli pond having an area of 250,000 m^2. This pond attains a temperature of 95°C in the storage zone. The hot water in the storage zone is circulated through a heat exchanger to boil a fluid like freon, the vapours of which are then expanded in a turbine to produce 5MW of electrical power.

Small solar ponds have been used for the extraction of sodium sulphate from ores in Argentina. With an area of 400 m^2 they can produce sodium sulphate at a cost lower then conventional extraction techniques A 2000 m^2 pond in the U. S. A. supplies heat to a swimming pool. In Italy, a 27,000 m^2 solar pond has been built for desalination of sea water. Solar ponds have been constructed in Australia, Mexico, Portugal, Taiwan, Japan and India.

In India the first solar pond was built in Bhavanagar in Gujarat. A 100 square meter pond has also been built in Pondicherry. With the assistance of the KSCST a 240 square metre pond has been built at the Indian Institute of Science for studies. This has been successfully working for the past 7 years. The temperature in the storage zone has never gone below 50°C in the past 7 years and the maximum achieved is 75°C. This is an achievement considering that Bangalore has long periods of cloudy weather. This pond has demonstrated the technical and economical viability of small solar ponds for meeting the process heat needs of hatcheries, dairies and silk filatures. Solar ponds convert solar radiation to heat with an efficiency of 15% to 20%. The drawback noticed is that sometimes algae grow in the pond thereby reducing transparency of pond. This can be prevented by adding bleaching powder or copper sulphate. Heavy winds over the surface should be prevented by construcing wind breakers. There is also a need for salt recycling since salt diffuses slowly to the upper layers. This must be compensated by injecting salt in the storage zone. When the salinity of the top layer becomes large, this water is removed, evaporated and the salt recycled. During summer, water must be added to the top layer to reduce density.

In India solar pond based small power stations can be located in Gujarat and Tamil Nadu since the cost of common salt is lowest in these two states. Also these two states have acidic land unfit for agriculture.

BRAZIL DECIDES TO SWITCH PALM OIL

The government announced that a new alternative energy source would be available to power heavy farm machinery and transport vehicles Palm oil.

"Dendiesel" a mixture of 74% Dendee palm oil and 24% diesel oil, has been used to power a test passenger car 50,000 miles (80,000 kms) yielding an average 42 miles per gallon (18 kms per litre).

A test passenger bus was powered 12,000 miles (20,400 kms) with Dendiesel for a year, with excellent results.

Brazil has available more than 170 million acres (70 million hectares) of land suitable to grow Dendee, a palm tree whose nuts produce 5 times more oil per acre than soy beans.

Cabrera also said the palm oil fuel was much cleaner when burned than conventional fuels such as gasoline or alcohol.

Brazil began to develop an ambitious alcohol fuel programme in the late 1970s following the oil price rises of 1973 and 1979.

About 30% of Brazil's 13 million vehicles run on ethanol, a type of alcohol made from domestically grown sugarcane.

Brazil imports nearly half of the 1.1 million barrels of oil it consumes daily. Before the Gulf crisis, this country of about 150 million people imported 160,000 barrels of oil a day from Iraq and 30,000 from Kuwait.

SOLAR ENERGY DETOXIFIES WATER

Scientists at the Lawrence Livermore National Laboratory and the Solar Energy Research Institute in the United States have shown that solar energy can detoxify water, reports the journal *Environmental Science and Technology*.

In their work, contaminated water, in this case containing trichloroethylene (TCE), a suspected carcinogen, is run through narrow, curved glass tube reactors. The curved glass reflects sunlight directly into the reactor.

A photocatalyst is added. The photons from sunlight interact with the photocatayst to decompose the TCE to level of less than one part per billion. One advantage claimed is on-site treatment with no need to collect contaminants on carbon or polymers and haul them elsewhere for processing, the journal said.

HONEY MIGHT REPLACE SULFITES AS PRESERVATIVE

A solution of honey might replace sulfites as a preservative. This follows research work by agricultural scientists in the United States.

JORDAN DEVELOPS NEW GREENHOUSE COVERING

A new, multilayer transparent covering film for plastic greenhouses has been perfected by researchers in Jordan, using recycled industrial waste. Scientists of the Jordanian Royal Scientific Society (RSS) report their product, which contains upto 60 percent recycled polyethylene from industrial waste, has considerable tensile strength and can be manufactured at low cost. The fact that it can be made locally also means the country can save an appreciable amount of foreign currency by using it. The product development project was carried out in collaboration with the Chemical Engineering Department of McGill University, Montreal, with support from Canada's International Development Research Centre (IDRC).

WOMEN MANAGERS IN TECHNOLOGY FOR DEVELOPMENT :

WEDC will hold its second four months course Women Managers in Technology for Development, from 28th September to 18th December 1992. The Course is for women with experience in Management of Water Supply, Sanitation and Drainage etc.

The main issues of the conference are : (i) Women Society and Wealth. (ii) Women in Management of Technology, (iii) Women in Management of Resources,

For further information contact :

WEDC
Loughborough University of Technology
Leicestershire LE 11 3 TU
England.

WATER, ENVIRONMENT AND MANAGEMENT :

Water. Engineering and Development Centre, (WEDC) England in collaboration with Nepal Engineer's Association, Nepal (NEA) will hold 18th WEDC conference on "Water, Environment and Management from 31st. August to 4th Sept. '92. The conference will be co-sponsored by the Federation of Engineering Institutions of South and Central Asia (FEISCA), UNICEF and other National and International Organisations.

The main topics to be covered in conference are : Water—Rural Water supply, Low cost Sanitation, Environment—The urban environment, Urban housing and planning. The rural environment Management—Community Management. Women in Mangement and Management for Sustainability.

For further information contact :

Mrs Rowena Steele
WEDC
Loughborough University of Technology
Leicester Shire Leil 3 TO
England.

BIOGAS TECHNOLOGY :

A Training course of Action for Food Production on "Biogas Technology for Supervisors/Technicians/Promoters" is being organised at AFPRO Aligarh Project, Aligarh U. P. India from January 6-10, 1992.

For further information contact :

Project Manager
AFPRO Aligarh, Project
A-6 Vikram Colony
Ramghat Road
Aligarh-202001,
U. P.

APICULTURE IN TROPICAL CLIMATES :

Fifth Internation Conference on Apiculture in Tropical Climates will be held from 7th-12th September '92 at University of West Indies in North West Trinidad.

For further information contact :

International Bee Research Association
(IBRA), 18 North Road
Cardiff CFI 3 DY, UK.

MICRO AND SMALL HYDROPOWER DEVELOPMENT

Swiss Centre for Appropriate Technology Switzerland (SKAT) will offer three to four weeks. training Course on "Micro and Small Hydropower Development". in August/September '92.

The course is aimed at Engineers and Technicians involved in either small scale hydropower development or equipment design and manufacture, technical managers and planners of small hydropower schemes and programmes and technical personnel of implementing agencies.

Tentative topics of the course will be :

(i) Hydrology (ii) Hydraulic theory of turbines (iii) Aspects of civil construction, mechanical and electrical engineering (iv) Concepts in the development of hydropower resources with reference to small plants (v) Planning, survey and layout methods. (vi) Installation, operation and maintenance and (vii) History of hydropower development in Switzerland in the context of its industrialisation.

For further information contact :

Swiss Centre for Appropriate
Technology (SKAT)
Tigerbergstrasse 2,
CH-9000 St. Gallen
Switzerland.

BOOK BAG

News and Notes on Books & Publications

WATER, LIFE AND POLLUTION

As life on earth depends on water is needed to fulfull diverse requirements in so many diverse ways. Water is not only essential to life but is the predominant inorganic constituent of living matter. It is a biological essential, supports all ecosystems, regulates global ecology, irrigates land to produce food and fodder, produces aquatic food, used in power generation and industrial processess and used in day to day life in many ways. To make best use of available water resources for human benefit and to prevent and control its depletion and degradation, it is necessary to know about physical, chemical and biological characteristics of water, causes of its pollution and its control, etc.

Present book provides a scientific appraisal of the facts relating water and is aimed at inculcating the awareness with regards to this very important resource.

The first chapter is on the Chemistry of Water second chapter deals with Physical, Chemical and Biological Characteristics of Water which is essential to evaluate the quality of water. Next three chapters describes about the water pollution, effect of water pollution on Human Health and water pollution control. Some aspects. Chapter fifth is on Waste Water Treatment and after that there are three Apendix and Glossary.

"Water, Life and Pollution" by Purohit Saxena, Published by Agro Botanical Publishers (India), Bikaner, 1990, pp 108, English.

CHOICE OF TECHNOLOGY IN INDUSTRY :

It is not uncommon to find many production units in low income, labour-abundant, capital, capital--scarce economics such as Tanzania employing sophisticated and capital-intensive production techniques. In such circumstances, problem of technology choice exists in the sense that the technologies in use, and more often the products being produced, are not compatible with the resource endowment of the economy and the income levels of the majority of the population.

This book evaluates the relative performance of alternative grain-milling techniques in Tanzania to identify appropriate ones and explain why some firms select inappropriate technique and products. The consequence of technology choice are then discussed within the context of employment creation, output expansion, surplus generation, skill promotion and overall resource use. The book is divided into seven chapters entitled : Choice of Technology—A conceptual Frame-work Study Area and Research Methodology, Evolution and structure of Grain-Milling Industry, Technology and Resource use, Economics of Scale and Process substitution and Major Policy issues.

The book is intended for students and research workers and economic development, particularly those in the field of economics and industrial technology.

"CHOICE OF TECHNOLOGY IN INDUSTRY :

The Economics of Grain-Milling in Tanzania", by M. S. D. Bagachwa, Published by International Development Research Centre, Canada, 1991, pp 144, English.

NATIONAL ENERGY : POLICY, CRISIS AND GROWTH

Energy occupies a key role in the development of an economy. Without it, it is not possible to achieve high growth rate whether it be agriculture, or industry, or mining, or transport-in fact-any economic sector. Even in social development like health, education, family welfare, urbanisation, etc., it occupies a central role. In fact energy is the focus around which the modern world revolves and thus determines its growth potential.

This book is mainly based on papers, presented in National Seminar on Energy Policy. The volume is divided into thirteen sections devoted to different aspects of energy. First two sections presents the excerpts from the inaugural address, keynote address, recommendations and a paper by the editor of the book. Section three and four contains the papers on national energy development prospective and national policy for a second energy system pricing of energy and energy consumption and demand management is discussed in fifth and sixth. In section seven, there are papers on energy conservation and privatisation. Next two chapters deals with the financial aspects of state Electricity Boards, and the Nuclear Power. From the papers in section ten we get an idea of the vast dimension of untapped alternative sources of energy. The role of energy in the rural areas finds a special place in section Eleven, Section Twelve deals with economics of human and animal energy. The last section Thirteen of this volume conclude the future perspective of energy demand.

The book covers a fairly vast area of Energy which it is hoped, would prove of help to students, researchers and teachers as well as administrators and policy framers.

"National Energy Policy, Crisis and Growth" by V. S. Mahajan (Ed.), Published by Ashish Publishing House, New Delhi, 1991, PP-413, English.

ENVIRONMENTAL DEGRADATION AND DEVELOPMENTAL STRATEGIES IN INDIA :

Land water and the air are the vital components of the physical environment surrounding the biosphere and provide the basic elements of the life support systems Human health and longevity are entirely dependent on the purity of these vital components. The growing population making increasing demand for food and other basic necessities of life has accelerated the process of exploitation of the environment on an unprecedented scale. The environmental deterioration is now causing ecological disbalance and there by for which man himself is responsible to a great extent threatening the very existence of life on this earth in near future.

There are many causes for such deterioration of environment and the level of degradation is different from area to area.

This book is the proceeding of the UGC sponsored seminar on "Environmental Degradation and Developmental strategies in India". The proceeding have been divided into six sections on the basis of nature and thrust area in the paper. The major six sections are :

(i) Environmental Management (ii) Basin Environment (iii) Coastal Environment (iv) Mountain Environment (v) Urban Environment and (vi) Rural Environment.

These papers will helped not only to the researchers, but also the planners and common people.

"Environmental Degradation and Developmental Strategies in India" by M. M. Jana, Published by Ashish Publishing House, New Delhi, 1991' pp 349. English.

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4. Futurama	—	(Forthcoming Events : Training Programmes, Seminars, Symposium, Workshop etc.)
5. Book Bag	—	(News on Books and Publications)

Note for the guidance of authors :

Papers/articles information packages, technical queries and related materials are cordially solicited. Manuscripts should be sent to :—

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Institute of Engineering and Rural Technology
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