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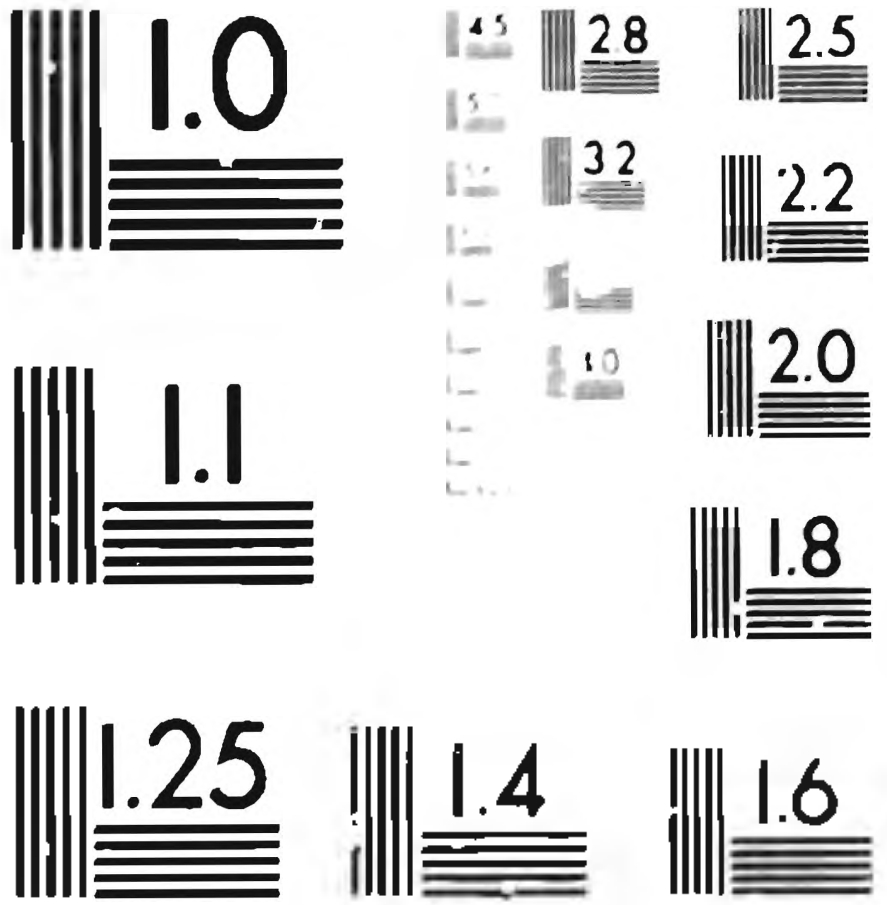

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UNIDO Activities in Fuels and Fertilizers from Renewable Resources

INTRODUCTION

Since 1967 UNIDO has been fulfilling its original mandate "to promote and accelerate the industrialization of the developing countries" by responding to requests from the Governments of those countries for technical co-operation in all aspects of industry.

This commitment to industry as a means of improving the living standards of lands containing nearly three-quarters of the world's population, first outlined in Resolution 2152 (XXI) adopted by the General Assembly of the United Nations on 17 November 1966 has since been intensified. In 1975 at the Second General Conference of UNIDO in Lima, Peru, a Declaration and Plan of Action on Industrial Development and Co-operation decided that every effort must be made to increase the share of world industrial production in developing countries to 25 per cent by the year 2000. It was at that time 8.6 per cent. One of the means to be employed was for UNIDO to "intensify and expand its present operational activities." A further point in the Plan was that the scope and functions of UNIDO needed to be expanded and its organizational machinery extended.

In the series of booklets of which this is one, the manner in which UNIDO's industrial operations in many separate sectors of industry have been performed is related, together with methods adopted to accelerate industrialization to the utmost.

Most of the money for well over 2000 projects a year in more than 120 countries, in regions and territories, comes from the United Nations Development Programme (UNDP) for which UNIDO is an executing agency. Increasing resources for the organization's own initiatives are arising from the United Nations Industrial Development Fund set up as a direct result of the Lima conference. In 1979 the Executive Director, Dr. Abd-El Rahman Khane, was able to report that delivery of services and equipment by UNIDO had grown by fifty per cent in the previous four years. The total value of projects approved was by then nearly $ 400 million, compared with $ 6.6 million in 1967–in both cases far more than could be accomplished in one year with the staff available.

Sectors of industry to be dealt with in this series of booklets, all within the sphere of the Industrial Operations Division of UNIDO, are:

Metallurgical Industries
Capital Goods
Computer Aided Design and Manufacture
Training
Pharmaceuticals
Building Materials and Construction Industries
Petrochemicals
Wood and Wood Processing
Quality Control and Standardization
Institutional Infrastructure
Packaging
Fuels and Fertilizers from Renewable Resources

CRISIS OF RESOURCES

During the past few decades the world has seen a rapid depletion of non-renewable resources for fuels and chemical raw materials. The rate of consumption is so high that a crisis has been provoked in the supply of at least one such resource, namely, oil and gas. This experience has forced the world community to rethink and strive to change from a "consumer society" to a "conserver society", while at the same time maintaining a healthy economic growth and continued improvement of living standards. There is a growing realization that this colossal task can only be achieved through appropriate technologies and policies on energy and materials conservation, fuels and chemical raw materials substitution, and recycling of wastes to provide fuels and raw materials.

The developing countries are now aware of the urgent need to adopt the approach of "conservation, substitution, and recycling" with respect to fuels and chemical raw materials, before their own societies become consumer societies on the same scale as in industrialized countries. They are also aware of the need to develop technologies and policies which will avoid over-dependence on oil and gas resources which are in critical supply.

In response to this growing awareness UNIDO is intensifying its technical assistance programme on the production of fuels, fertilizers and chemical raw materials from renewable and non-critical resources. (The term "non-critical resources" denotes those sources of energy that do not involve raw materials such as oil which, in the present state of technology, are in short supply. Non-critical resources therefore include renewable resources such as biomass; natural gas; peat; low-grade coal; oil shale and tar sands). Thus the programme covers the following areas:

production of compost from municipal solid wastes,
biogas and fertilizer from rural and agricultural wastes,
alcohol for fuel and chemical feedstock from fermentable crops,
fuels and chemicals from wood wastes,
fuels and chemicals from dry biomass materials such as bagasse, straw, rice husks, corn cobs,
liquid and gaseous fuels and chemical raw materials from coal, and
fuels and fertilizers from peat.

COMPOSTING MUNICIPAL SOLID WASTE

Composting is a process in which micro-organisms break down organic matter to a relatively stable humus-like material. It is one of the oldest solid waste disposal methods and has the capability of converting municipal garbage and other organic waste solids to a product which has a lower bulk volume than the original waste, is stable, and has the potential of being recycled into the ecological sphere through its use as soil conditioner and fertilizer.

Compost is not a substitute for, but rather a complement of, mineral fertilizers. Its main value is in raising the organic matter content of the soil by providing it with humus. It is generally in great demand by vegetable and fruit growers in the vicinity of big cities, by home gardeners and for use in municipal parks and gardens.

Since the present technology of composting permits the recycling of organic waste materials back to the soil without significant pollution of water or land resources, composting has become an attractive alternative to dumping, landfilling or incineration as a method of municipal garbage disposal.

Many developing countries are therefore finding an economic solution to their rapidly increasing urban refuse problems through the establishment of compost plants.

Further, although urban refuse composting can meet only a small portion of a country's fertilizer needs, in many cases it may provide the only fertilizer readily available. It may also provide the most economic method of urban waste disposal, because labour costs are low in developing countries and their urban refuse contains a far higher percentage of organic matter than that from cities in industrialized countries. There is therefore a strong case for urban refuse composting in developing countries not only in meeting the needs of market gardeners but as a means of alleviating the public health problem of waste disposal. Accordingly, urban compost programmes are being planned and implemented in a number of developing countries.

UNIDO'S ROLE IN ENSURING PROJECT VIABILITY

As part of the programme, supported by FAO and UNEP, of promoting the use of organic materials as fertilizers, UNIDO has, since 1970, been providing technical assistance to developing countries in the production of compost from municipal garbage.

In addition to carrying out feasibility studies for compost plants at Aden, Bamako, Bujumbura, Conakry, Cotonou, Damascus and Ouagadougou, UNIDO has been providing a comprehensive programme of assistance to Morocco to rehabilitate and improve the efficiency of existing compost plants at Rabat, Meknes, Tetouan, Marrakech, and to train Moroccan personnel in the operation, maintenance and repair of compost plants. Advice is also given in the marketing and application of compost. In addition, UNIDO has assisted in rationalizing and improving the efficiency of garbage collection in Casablanca to ensure a regular supply of raw material for its new compost plant.

Since both garbage and compost are high-bulk, low-value materials, it is imperative that capital and production costs should be low, particularly in view of the fact that the quality of the product often bears no relation to the degree of sophistication of the machinery and the process. Composting technologies available in developed countries are generally too sophisticated and expensive for developing countries, and this is the reason why many plants have had to be shut down.

Process adaptation is therefore an important factor in ensuring the viability of a compost plant. This can be achieved, as experienced by the UNIDO project in Morocco, through insistence on simplicity in process and plant design, maximum local fabrication of equipment and standardization of plants for different cities within the country for ease of maintenance and repairs.

The Moroccan experience has shown that, in addition to the above technical problems, there are problems of organization and infrastructure concerning the operation of the garbage collection system, operation of compost plant, distribution and marketing of compost, and in particular, the division of responsibility between the municipal and agricultural authorities in all these matters.

Since considerable time and investment are required for the optimization of garbage collection system and market development for compost, UNIDO recommends a stepwise approach, beginning with the establishment of a pilot plant or a plant of low initial capacity to be expanded later or duplicated at other suitable sites around the city or at other cities. This approach also takes care of the problem of the ever-changing perimeter of fast-growing cities.

Following feasibility studies carried out by UNIDO, a pilot compost plant is being established at Aden, Yemen and another is being planned for Conakry, Guinea.

BIO-GAS TECHNOLOGY

Energy, fertilizer and rural development are priority development objectives. Bio-gas technology not only supplies energy (bio-gas) and organic fertilizer from renewable waste materials, but also alleviates the problem of waste disposal and pollution control. Furthermore, owing to its simplicity and the possibility for local fabrication of the equipment, bio-gas technology is particularly suitable for rural areas.

The value of a bio-gas installation (as for many other investments) depends on the viewpoint, of for example the individual family, the community, or the nation. It also depends on the particular circumstances of its location such as the current source of energy, previous use of animal dung (particularly whether it is burned) or other input material; or at the national level, the foreign exchange cost, if any, associated with the supply of fuel and fertilizer. Some of the benefits may be difficult to quantify but, in general, would include:

At the personal level –

Fuel for fast clean cooking and better lighting;

Better use of time otherwise spent in gathering fuel, and in cooking with less satisfactory fuels;

Improved sanitation, particularly if toilet is incorporated with the bio-gas installation;

Improved availability of low-cost fertilizer, resulting in higher crop yields;

Depending on gas supply, fuel for engines for pumping or other purposes.

At the community level –

Reduced pollution from untreated animal and human wastes;

Increased productive employment in industries related to construction of bio-gas plants;

Increased scope for small-scale industries.

At the national level –

Reduced need for foreign currency for energy imports;

Reduced resource requirement for energy production and distribution in rural areas;

Reduced destruction of forests and erosion of soils.

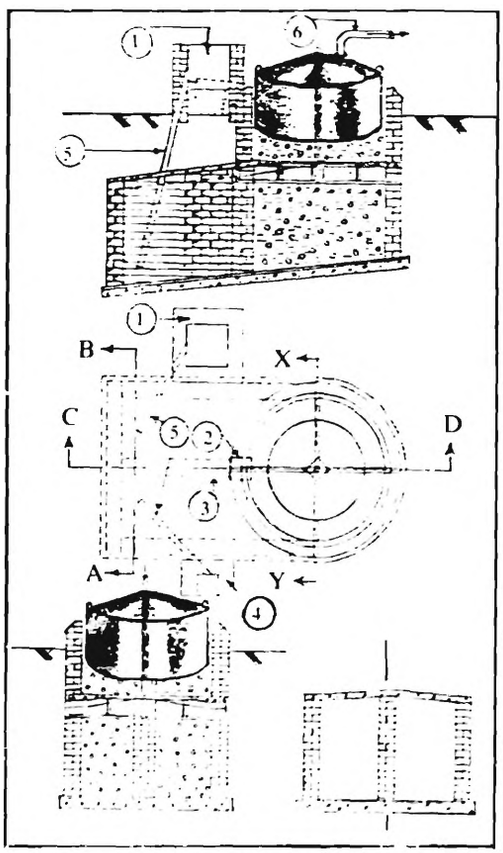


Fig. 1: Biogas Plant: Horizontal Type Design (By courtesy of Mr. H. R. Srinivasan, Khadi and Village Industries Commission, Bombay, India)

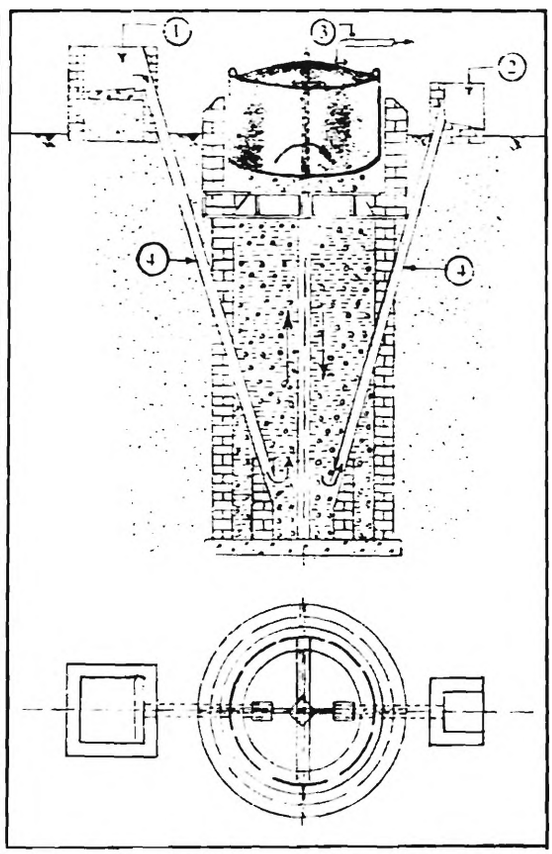


Fig. 2: Biogas Plant: Vertical Type Design

IMPACT ON RURAL INDUSTRIALISATION

It is clear that the propagation of bio-gas technology in rural areas can nave a favourable impact on their industrialization. Among the activities related to the construction of bio-gas plants is the manufacture of such items as gas holders, gas stoves, gas lamps, pipes, valves, welding conversion kit, engine

conversion kit, etc. The availability of the gas could also increase the scope for the development of other small-scale village industries and generally encourage the development of rural entrepreneurship.

NEED FOR DEMONSTRATION PLANTS

Many developing countries, among them China, India and Korea, have long-established bio-gas development programmes, and complete designs of bio-gas plants of different capacities and types are available. However, the choice of a particular design has to be made after careful assessment of the local conditions, and the design chosen has to be demonstrated to work, and to work competitively, in the poor rural areas of the country.

Other reasons why a demonstration project is essential for bio-gas development are:

the cost benefit ratio depends largely on local conditions;

the bio-gas plant should be managed as the core of an integrated system with many possible variations in input material and slurry utilization, and these should be incorporated in measures to promote its use, as well as in design and operation;

it is not possible to force bio-gas development ahead of the genuine interest of the people concerned, and of their commitment to proper operation and maintenance – hence the need for a demonstration project to arouse public interest;

considerable planning of infrastructure and mobilising of financial resources (Government loans, subsidies, etc.) are needed; and

a sound technical advisory service is needed to improve cost effectiveness and to promote reliability of plant design through standardisation.

UNIDO ASSISTS TECHNOLOGY TRANSFER

UNIDO's approach is to assist in the transfer of bio-gas technology from countries, such as China, India and Korea, where it has been firmly established, to countries mostly outside the Asian region which are interested to benefit from the Asian experience. This is to be done initially through demonstration projects carried out at the request of the Government of the recipient country.

It is also envisaged that UNIDO may assist in the development of bio-gas technology at a somewhat larger, industrial scale. An example could be the establishment of a sizeable bio-gas plant fed by wastes from a livestock farm and meat processing plant where the gas can be used as fuel for running the plant machinery and the slurry for growing algae to feed the fish in an integrated farming system.

FERMENTATION ALCOHOL PROGRAMME

A Workshop held in Vienna in March 1979 called upon UNIDO to assist developing countries in the production of fermentation alcohol for use as fuel and chemical feedstock, and to seek the co-operation of the Food and Agriculture Organization (FAO) with regard to the agricultural aspects of production.

A similar recommendation was made at the First Consultation Meeting on Petrochemical Industry held by UNIDO in Mexico City in March 1979.

UNIDO's overall programme will consist of:

General studies on the economics of fermentation alcohol production from different raw materials, e. g., cane juice, molasses, cassava

General studies on the economics of ethanol-based production of industrial chemicals

Technical assistance for improving existing distilleries and ethanol-based chemical plants

Fuel alcohol test programmes

Establishment of technology centres where appropriate

Planning and establishment of new and additional capacities for production in suitable interested developing countries.

The main merits of a fermentation alcohol programme, particularly for developing countries lacking petroleum resources, are:

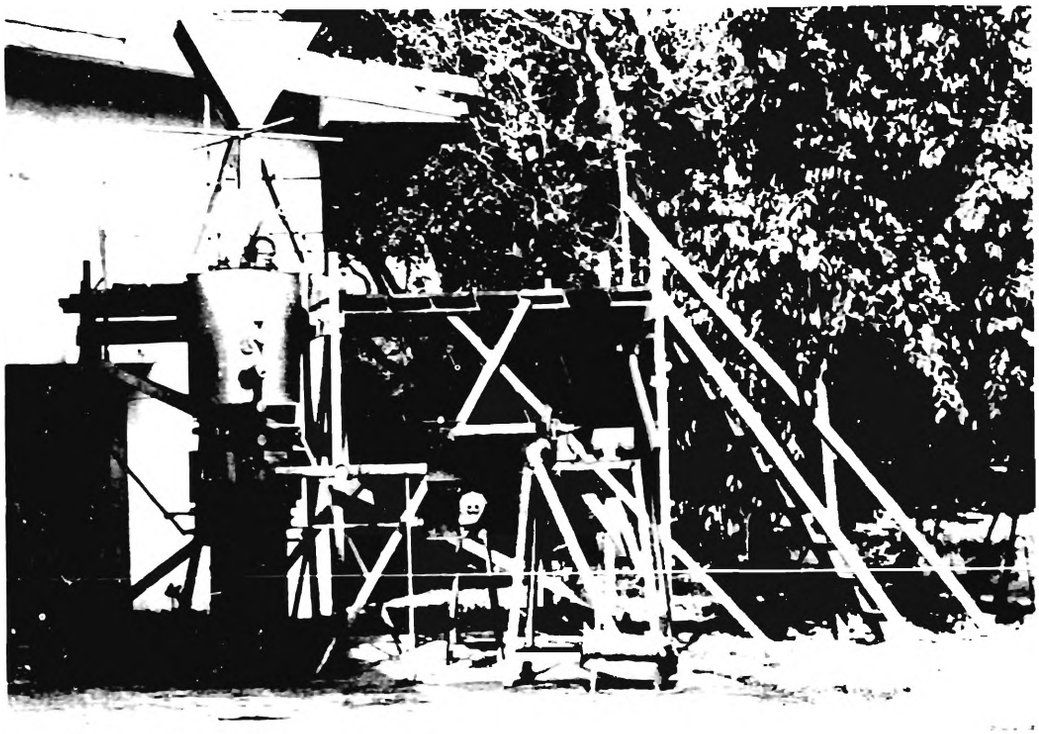
Increasing the value added to agricultural products

Local development of ethanol-based industrial chemical production

The benefits of agro-based industrialization to both agriculture and industry

Savings of foreign exchange currently used for petroleum imports and consequent improvement of their balance of payments.

Top View – Pyrolysis Reaction Chamber



Completed Pyrolysis Unit

Condenser after Trial Run