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Workshop on Fermentation Alcohol for Use as Fuel
and Chemical Feedstock in Developing Countries

Vienna, Austria, 26 - 30 March 1979

# EXPERIENCES WITH THE BRAZILIAN POWER ALCOHOL PLANTS*

by

O. Prado**
G. Costa Coimbra***
G. Anderle****

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ABSTRACT

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ABSTRACT

# EXPERIENCES WITH THE BRAZILIAN POWER ALCOHOL PLANTS *

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In 1975, Brazil has developed its alcohol programme due to the following six main reasons:

- saving of foreign bills
- support of the national industry
- increase of the gross national product
- development of the agriculture in under-developed regions
- balance of regional economic differences
- creation of possibilities for work in regions which are economically under-privileged

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The first phase of realization of the alcohol programme foresaw the economic utilization of molasses to alcohol; the second phase the utilization of juices from sugar production and furtheron the complete utilization of cane in the autonomous distilleries. For this, it was and it is necessary to enlarge the cultivation area and to reconstruct the existing sugar mills in such a way that the delivered quantity of cane can be processed, and to project with such a flexibility that, adjusted to the demand on sugar, the alcohol production can be regulated. In the third phase, all starch- and cellulose-containing raw materials,like mandioca or bagasse, should be utilized. With this alcohol programme the alcohol production was increased in the years 1975 to 1978 from 8 million litres to 2.500 million litres, which means that 120 plants with a medium capacity of 100.000 litres have been erected by Brazilian manufacturers of equipment.

Besides of the economic advantages the alcohol programme brought also a valuable knowledge on the fields of agriculture, biotechnology and energy; the decisive position of the agro- industry, especially the alcohol technology, in the actual energy conception was discovered. This recognition motivated also other countries to develop proper alcohol programmes.

## Fermentation Alcohol for Use as Fuel and Chemical Feedstock

### Guidelines on planning fermentation alcohol industry in developing countries.

### The Brazilian Experience
(The National Alcohol Programme)

It has always been mankind's aim to improve the quality of life and to achieve the fulfillment of the individual.

There are two main obstacles that hinder the achievement of such goals:
Shortage of energy sources and shortage of food. This situation is even worse among us, countries of the third world, that are subject to a lot of problems, the solution of which seems to get always more difficult, getting us dangerously close to the level of absolute poverty.

We may say that the creation of OPEC was the first definite step on the part of the developing countries towards awareness of the importance of their natural resources for their economic and social progress.

The example of the OPEC countries must be followed by us, and in addition to this, massive investments in human resources and research programmes, aiming at developing

technologies that allowed us to increase the economic value of our natural resources, must be made.

On the other hand, it is also important for us to intensify the scientific and technological cooperation and integration with the other developing countries, especially with those in the tropical and sub-tropical areas, which have to face similar problems and can therefore join efforts for common solutions. This integration is also important in our relations with developed countries, inasmuch such strategy can set off a chain of political components that can contribute to the optimum absorption of foreign technology and propiciate the transference not only of the Know-How but also of the Know-Why, thus preventing our technological progress from being only apparent and with no multiplying effect.

We are honoured by the opportunity that has been offered to us by the United Nations Industrial Development Organization, the Austrian Government and the VOGELBUSCH Gesellschaft to participate in this workshop.

We would like to explain some relevant aspects of the Brazilian experience concerning substitution of alcohol for oil as an alternative energy source.

We believe indeed that the development of alternative energy sources, especially renewable, can create very favourable ground for the correction of economic inequalities and for more equitable relations between nations, thus promoting greater social justice.

Since 1973, when oil prices went up 300 % in only three months, Brazilian economy has become extremely vulnerable.

In order to relieve and, if possible, solve the problems brought about by the oil crisis, Brazil passed a federal law creating the national alcohol programme, which constitutes a series of systematic measures, involving government departments, research centres, agro-businessmen, engineering firms and equipment industries, aiming basically at a quick expansion of alcohol production and at making alcohol increasingly viable both as fuel and as chemical feedstock.

The basic guidelines taken into account in the creation of the Brazilian alcohol programme were:

1. The pressing need to decrease the galloping rhythm of our foreign debt, owing greatly to increased oil prices,

2. the considerable Brazilian agricultural potential,

3. favourable climate and soil conditions for the growth of species suitable for alcohol production under viable economic conditions,

4. the existence of a substructure for the cultivation of sugar cane and production of sugar,

5. the existance of industry able to cope with the manufacturing of equipment for alcohol production.

Based on the above mentioned facts, the following goals were established:

Saving of foreign exchange credits is the main goal, through a cut down of expenses in oil imports.

Secondary goals are:

1. to decrease regional income inequalities, since the setting up of autonomous distilleries in pioneer areas significantly favours the growth and diversification of economic activities around them,

2. to decrease individual income inequaulities, since manpower intensive technology offers many job opportunities, thus contributing to solve two crucial problems: under-employment and migration towards the cities,

3. expanding the economic frontiers, since the extensive-type cultivation of sugar cane, manioc and other raw materials for alcohol production enables the incorporation of new areas that have not yet been included in the national economic development,

4. increase of capital goods production, since the setting up of a distillery requires a considerable amount of industrial goods, stimulating various branches of industry in backward linkage form.

Between 1973 and 1975 several different ways of increasing the Brazilian alcohol production were discussed. What would be the ideal type of alcohol to be produced - methanol or ethanol? If ethanol, which raw material or materials should it be extracted from?

It was finally decided to increase immediately the production of aethylic anhydrous alcohol obtained first from sugar cane and then from manioc. It was also decided to promote the setting up of combined sugar cane/manioc distilleries in suitable locations.

Thus, the production of hydrated alcohol was postponed, since it would not be possible to use it in the adopted plan of gradually mixing alcohol with petrol and diesel oil, by-products that take up as much as 50 % of oil refining.

The choice of sugar cane as the principal raw material for the production of aethylic anhydrous alcohol arises from the following reasons:

1. Brazil is traditionally a big sugar cane producer, with over 4 million acres of plantation,

2. Brazil exports a large amount of sugar and can thus combine sugar and alcohol production according to international sugar prices,

3. compared with other sources, sugar cane yields the highest rate of alcohol per acre,

4. as alcohol can be obtained from molasses, a sugar cane by-product, it is possible to set up distilleries attached to the existing sugar mills, thus making investments far more profitable and allowing a more operational flexibility,

5. bagasse can be used for fuel, which makes an alcohol distillery self-sufficient as far as its energy and thermic needs are concerned,

6. the excess of bagasse obtained in the production of alcohol can be stored and used as fuel for the processing of other raw materials after the sugar cane harvest.

Once sugar cane was choosen as the basic raw material in the production of anhydrous alcohol, the next step was to choose the areas where the distilleries would be set up. Here the criteria to be observed were climate and soil conditions, as well as socio-economic and market aspects.

Thus the following points were considered as most relevant when analyzing a new distillery project:

1. reduction of regional income inequalities,

2. availability of the necessary agricultural and industrial production factors,

3. transportation costs,

4. prevision of future enlargements of the distilleries productive capacity so that no future raw material supply problems would arise between neighbouring units.

Based on these criteria, certain preferencial regions were selected for setting up autonomous and attached alcohol distilleries.

Between 1975 and 1978, 210 projects were approved for the installation or enlargement of distilleries, with a total production capacity of more than 30 million litres of alcohol per day, i.e. more than 5 thousand million litres per year.

At present, more than 200 attached and 25 autonomous distilleries are operating or beginning to operate. In 1979 they are expected to produce 3 and a half thousand million litres, which places Brazil as the world's largest alcohol producer.

In the effort to substitute alcohol for oil by-products, Brazil has increased its alcohol production 17 times in 6 years, i.e. from 200 million litres in 1973 to 3 and a half thousand million litres in 1979.

During the 80/81 sugar harvest the production of 5 thousand million litres per year should be reached, which will allow us to adopt a mixture of 20 % alcohol in the petrol and 4 % in the diesel oil. By then, this practice should be in the full use all over the country.

From this point onwards, future increases in alcohol production should be used as follows:

1. to keep the pace with the increase in fuel consumption, keeping the mixture rates at 20 % and 4 %.

2. to produce aethylic hydrated alcohol to be used as fuel in vehicles and engines adapted to this end. The number of such cars is expected to increase gradually, beginning with those that belong to government departments and to large companies,

3. to increase the use of alcohol as chemical feedstock, while alcohol technology is developed and its economic viability granted.

Being this programme of such large range and deep parallel effects, it is important to emphasize the role of the government as stimulating and coordinating agent.

On the one hand, good care has been taken to prevent the transformation of the programme into a sheer monopoly, on the other hand it has been also avoided laying it in the sole hands of private enterprise, without offer/demand regulating mechanisms.

In the adopted strategy both parts play an active role, so that risks will not be concentrated and the results of the programme, mainly the socio-economic ones, will be shared with fairness.

The government stimulates both the agricultural and the industrial sector through long term loans, up to 12 years, at interest rates below inflation rate.

The government regulates the whole process, approving or suggesting modifications in installation or enlargement projects, taking as basic criteria agricultural productivity and market aspects.

The government also regulates alcohol commercialization, setting patterns and rules for prices and mixtures rates. It also holds itself responsible for, or is at least, coordinator of the transportation and distribution of the product.

On the other hand, a programme that has already required many million dollars in investments entails the following positive aspects:

1. that sugar mill owners may make their investments more flexible and profitable,

2. that small and medium farmers may get together forming cooperatives or other types of associations, for a thoroughly enterpriselike activity,

3. that businessmen from other areas may direct part of their investments to an agro-industrial sector that presents low risks and satisfactory rentability,

4. that national engineering may develop and expand its markets, participating not only as a consultant in the

setting up of new projects, but also researching into new technology,

5. that the producers of agricultural and industrial equipments may expand their markets and increase their production, thus making their companies more competitive and their investments more profitable,

6. that technicians and farm and factory workers may have more job opportunities and better salaries,

7. that the Brazilian community as a whole may not be subject to unpleasant measures such as fuel rationing,

8. that the national independence, integrity and security may not be affected.

As the Brazilian alcohol programme has come into existence only a short time ago, it is still not possible to fully evaluate its results.

However, we can already state that the alcohol production obtained up to now has allowed Brazil to reduce its oil imports in 20 million barrels in 1978 which is equivalent to nearly 10 % of our oil imports and represents an economy of some 300 million dollars.

The widening of the economic activities can already be felt, mainly by the coming into operation of 25 autonomous distilleries, which means the creation of 75 thousand new jobs, benefitting indirectly more than 400 thousand people. Here we are not taking into account the reflexes that will certainly be felt on the industrial areas connected with the production of equipment and other necessary items for alcohol producing enterprises.

It should also be mentioned that the systems devised for storing, mixing and distributing anhydrous alcohol have not yet met with significant bottlenecks.
Storing and transportation have not been causing delays in the immediate utilization of alcohol in accordance with the original plans.

Engines using a mixture of petrol and alcohol have not shown any significant loss of efficiency or durability. Since the addition of alcohol to petrol raises octane, addition of tetraethyl lead becomes unnecessary. This fact is already causing a perceptible decrease in the air pollution of our large cities.

At present, the main challenges to Brazilian alcohol engineering are:

1. to increase the utilization of sugar cane and manioc residues as feed and fertilizers,

2. to devise economically viable mini- and micro-distilleries, so that pioneer areas and agricultural enterprises may become self-sufficient as far as energy is concerned,

3. to research into new technologies and new processes in alcohol-chemistry,

4. to increase the thermic efficiency of sugar mills and distilleries,

5. to utilize the bagasse surplus - a raw material that costs virtually nothing - in cellulose and pressed - board industries,

6. to utilize the yeast obtained in the fermentation processes as a component in high-protein food for human consumption,

7. to research new materials for alcohol production,

8. to devise distilleries that can extract alcohol both from sugar cane and from manioc, thus increasing their production cycle from 180 up to 330 days per year.

Since this last item is extremely important for the internal economy of a distillery, as well as for the economy of Brazil in general, and possibly of other developing countries as well, we would like to add some comments about it.

It can be obeserved that a sugar cane distillery producing 120 thousand litres of alcohol per day is more than self-sufficient as fas as energy is concerned, and that it generates a surplus of bagasse that can cause disposal costs if it is not adequately dealt with. Thus, sugar cane can not only generate alcohol but also the necessary energy to extract alcohol from manioc or other sources.

Combined sugar cane/manioc distilleries are those that can process sugar cane 180 days a year, during the harvest period, and extract alcohol from manioc during the remaining 150 days of the year, using the bagasse surplus as energy source.

This combination arises from the fact that the processing of manioc requires an external energy source for the production of steem and electricity.

The bagasse surplus, on the other hand, can be stored during the harvest period and used to process manioc.

At the same time of the sugar cane harvest, small manioc farms located near the combined distillery could produce manioc chips.

Not only Brazil but also African, Asian and other Latin American countries have an enormous potential and large experience in manioc chip production. In most of these countries, manioc is processed in a very simple and empiric manner, through manual washing, peeling and sun-drying.

Manioc chips obtained in these small farming units could be stored during the sugar cane harvest and then sent to a nearby combined distillery for alcohol extraction.

The combined distillery would have to be modified only in the size of its steam, power and fermentation installations. Cooking and saccharification sections would be the only ones added to the complex.
Such a combination of raw materials in the same distillery will have the following advantages:

1. the extraction of alcohol from manioc will become viable energy-wise,

2. the rentability of a combined distillery will be much higher than that of distilleries processing only sugar cane, since the production will take place up to 330 days per year.

3. the duplication of alcohol production with an additional investment of only 30 to 40 %,

4. reduction of industrial costs,

5. incorporation into the alcohol economy of those regions, areas and economic structures which are oriented towards manioc production rather than to sugar cane,

6. a broader range of by-products per distilling unit.

Technologists, administrators, businessmen, farmers, government officials, whom we have been able to meet here thanks to this UNIDO-Workshop, and especially to the representatives of developing countries, whose production structures and socio-economic conditions are somewhat similar to ours, that Brazil is only beginning its battle for energy self-sufficiency and that we are interested not only in sharing the preliminary results of our experience, but also in intensifying technological cooperation and promoting an ever-greater integration centred upon joint research and development programmes, so as to gain faster and more definite results and to universalize their benefits as much as possible.

The conquest of alternative energy sources depends on the political will, aimed at coordinating and vivifying the capabilities of a nation to encompass all the production factors available.

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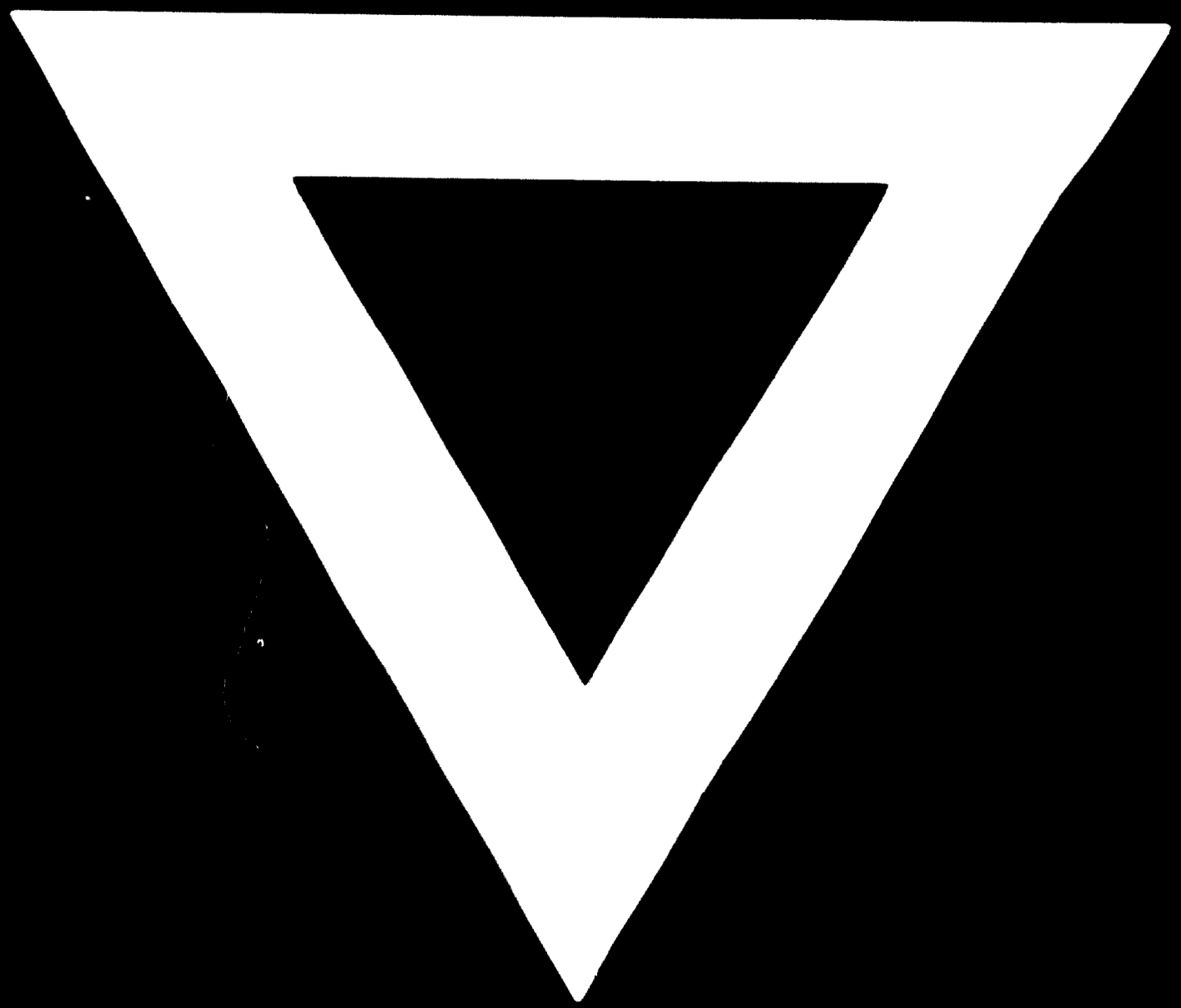

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