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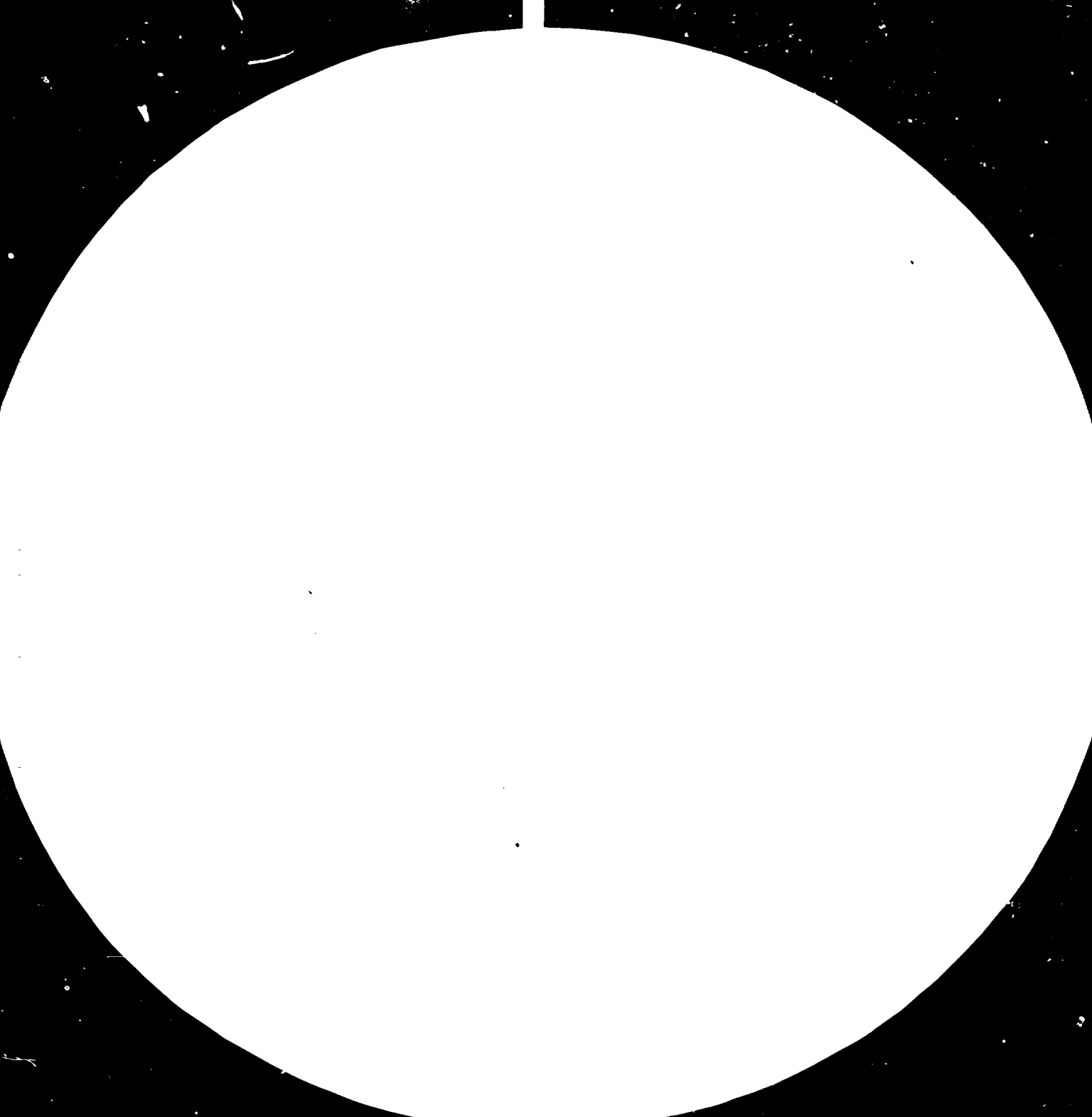
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HOW THE RONGXIAN COUNTY DISTILLERY IN
SICHUAN EXPLOITS BIOGAS *

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The Rongxian County Distillery in Sichuan Province is a medium-sized distillery with a working body of 247 people, and produces 3000 tons of liquor every year. In the last few years, they have been using the wastes discharged during liquor making to produce biogas, which is then exploited in a comprehensive way. One of the uses they have found for bio-gas is to generate electricity. In so doing, they have solved the problem of environment pollution, saved much fuel and provided the countryside with a great deal of organic fertilizer. The exploitation of biogas has also brought many changes to the distillery's production and workers' life. The distillery has been awarded the title of an advanced unit in the exploitation of biogas.

Starting from the Interests of the People

As Sichuan lies in a hilly land, the peasants grow an abundance of sweet potatoes. Sweet potatoes contain much water, which makes it difficult to keep them for long. Sweet potatoes can easily go mouldy and rotten and this often makes the peasants suffer a big loss in economy. In 1974, a mechanized liquid fermentation plant with a yearly output of 2000 tons of liquor was built in the Rongxian County Distillery in answer to the government's call of saving grains. The plant experimented successfully on the use of rotten sweet potatoes and starch-rich wild plants as grains substitutes for making liquor. They found that 3 kg of rotten sweet potatoes could produce 1 kg of ordinary white spirit.

They paid the peasants only 8 fen for 1 kg of rotten sweet potatoes. In the last five years they have purchased 25,444 tons of rotten sweet potatoes and other raw material substitutes and produced 6,431 tons of liquor substitutes (the raw materials are not yet used up). They have saved 12,722 tons of grains, handed over to the State more than 5,900,000 yuan as profits and tax payment, and made it possible for the peasants to earn more than 1,140,000 yuan of extra money by selling rotten sweet potatoes. Always bearing in mind the interests of the people, the Rongxian County Distillery has not only helped the peasants make up for their loss due to rotten sweet potatoes, but also increased their own production to meet the demand of the markets.

Disposing of Wastes by Means of Bio-Gas Production

In making liquor with rotten sweet potatoes, the newly built plant would discharge more than 100 tons of used distillers' grains and liquid everyday. As these wastes tasted bitter and contains much acid, they could neither be used as fodder, nor as fertilizer. The environment was often seriously polluted by the wastes which had not been disposed of properly or in good time by the distillery. The discharges often flowed into the nearby rivers, causing the river water to become black and smelly. Smarting with such severe environment pollution, people and other units complained a lot. Just because of this pollution problem, the distillery was forced to shut down for 8 months between 1975 and 1977, causing a loss of more than 1,300 tons of liquor or 1,350,000 yuan RMB.

In order to solve the problem of pollution, they made great efforts, spent much money and took many measures. For instance, they bought a pond to deposit the discharged wastes in; laid a pipe line to transport the wastes into an underground

cave by the side of a mountain; and resorted to presses, centrifuges and chemicals to treat the wastes. All these efforts went for nothing in the end.

It is the exploitation of bio-gas that has brought them success. After it has been fermented and decomposed by bacteria in a tightly-sealed bio-gas digester, the great quantity of used grains and liquid becomes organic fertilizer which, when carried back to fields, can be easily absorbed by plants. That will put an end to pollution once and for all.

The workers gained experiences from their two experimental digesters of 66 m³ and 900 m³ respectively. In 1978, they made up their minds to build a large bio-gas digester of 2,000 m³. With the help from outside the distillery, they designed a U-shaped biogas digester to cater for the particular characteristics of the distillers' raw materials for fermentation. The materials they used for the construction of the digester were concrete and slabs of stone. As the distillery uses liquid yeasting technology in making liquor, the raw materials fed to the digester are liquids and can flow slowly in the digester. Stirring facilities can therefore be dispensed with. When discharged from the plant, the wastes are at a temperature of 90 deg C, and only when they have been cooled down to about 50 deg C will they be fed into the digester. An appropriate amount of lime is added to the raw materials before they enter the digester to keep the PH value (acidity and alkalinity) at 7 -- 8. The first feeding was 1,400 tons of raw materials and from then on about 140 tons of materials are fed into the digester everyday. Because the liquid materials are rich and hot, daily bio-gas output reaches 2,000 -- 2,700 m³ or more. Measurements have shown that the bio-gas produced contains 65% of methane. The problem of pollution has been thoroughly solved ever since this bio-gas digester went into operation.

Benefiting from Comprehensive Utilization

The Hongxian County Distillery has gained the following benefits since its exploitation of bio-gas.

1. Continuous increase of profits

In the past this distillery used to stop production more than two months every year because of pollution problems. Now all the wastes are treated in the 2,000 m³ digester to become non-toxic. The distillery no longer has to shut down due to pollution. This year, they have installed a Type 160 diesel-power generator set (185 hp and 120 kw), using mixed gas-diesel combustion for power generation. The set operates 10 to 12 hours everyday with a fuel saving rate of 75% or more.

30,700 kw-hr of electricity were generated between January 8 and March 26. During this period, the State-owned power network stopped supply for five days; however, the distillery, blessed with its own power supply, was able to continue production and keep the adverse effects to a minimum. In the past the annual output of the distillery had never exceeded 2000 tons of liquor; but, last year, it produced more than 2500 tons of liquor of much improved quality. The 150 tons of hard liquor of last year's yield have been ranked among the best liquors in Sichuan Province. This year, they plan to make 3000 tons of liquor, including 2000 tons of liquor substitutes, and that will make the substitutes yeasting plant reach its design capacity for the first time. Profits of the distillery keep increasing every year. They were 80,000 yuan in 1974, reached 260,000 yuan last year and are targeted up to 500,000 yuan by this year's plan.

2. Reduction of production cost and improvement on workers' life

The distillery's canteen has been using bio-gas for cooking ever since the first 66 m³ digester was built. With more bio-gas being produced in the last two years, the distillery also

uses bio-gas to heat the boilers, distill water, boil drinking water, and heat houses. The factory also provides the 48 worker's households with bio-gas fuel for daily use. Statistics show that 507 tons of coal and charcoal were saved last year. A boiler for liquor making used to consume about 800 tons of coal every year in the past. However, when mixed gas and coal combustion is used for the boiler, more than 300 tons of coal, an expenditure of more than 6000 yuan, can be saved every year. Using bio-gas as fuel for cooking, the canteen reduces the price of one kilogram of cooked rice by more than 2 fen. These savings enabled the distillery to buy a TV set, build a bath-room, a tea-house, a club, a library and more than 2,000 m² of houses for the workers.

3. Support to agriculture with fertilizer converted from wastes

Since the operation of the 2,000m³ bio-gas digester, the 100 tons and more of wastes discharges by the distillery everyday have all been fed into the digester, where, after bacterial fermentation, they become very good organic fertilizer. For the last year or so, the distillery has altogether transported more than 57,800 tons of bio-gas fertilizer free of charge to 212 commune production teams. Chemical analyses indicate that the distillery's bio-gas fertilizer contains 0.69% of pure nitrogen, 0.113% of pure phosphorus, 0.417% of pure calcium and 4.1% of humus. It is universally acknowledged among the production teams that bio-gas fertilizer greatly helps to increase harvest. The second production team of the sixth brigade of the Fudong Commune in Rongxian County has presented their experiment results of the fertilities of various fertilizers in the following table from their long-period experiences of using bio-gas fertilizer.

Table of Fertility Comparison

crops	amount of fertilizer per mu ($\frac{1}{15}$ hectare) (kg)	fertilizers used	yield per mu (kg)	harvest increase ratio (%)
early rice	1000	farm manure	202	
	1000	bio-gas fertilizer + 3% ammonia water	340	34.6
	1000	bio-gas f. + 5% P_2O_5	320	26.6
	1000	bio-gas f.	280	10.8
maize	1000	farm manure	188	
	1000	bio-gas f. + 3% ammonia water	218	14.1
	1000	bio-gas f. + 5% P_2O_5	232	26.3
	1000	bio-gas f. + 5% farm manure	229	21.7

4. More benefits from comprehensive utilization

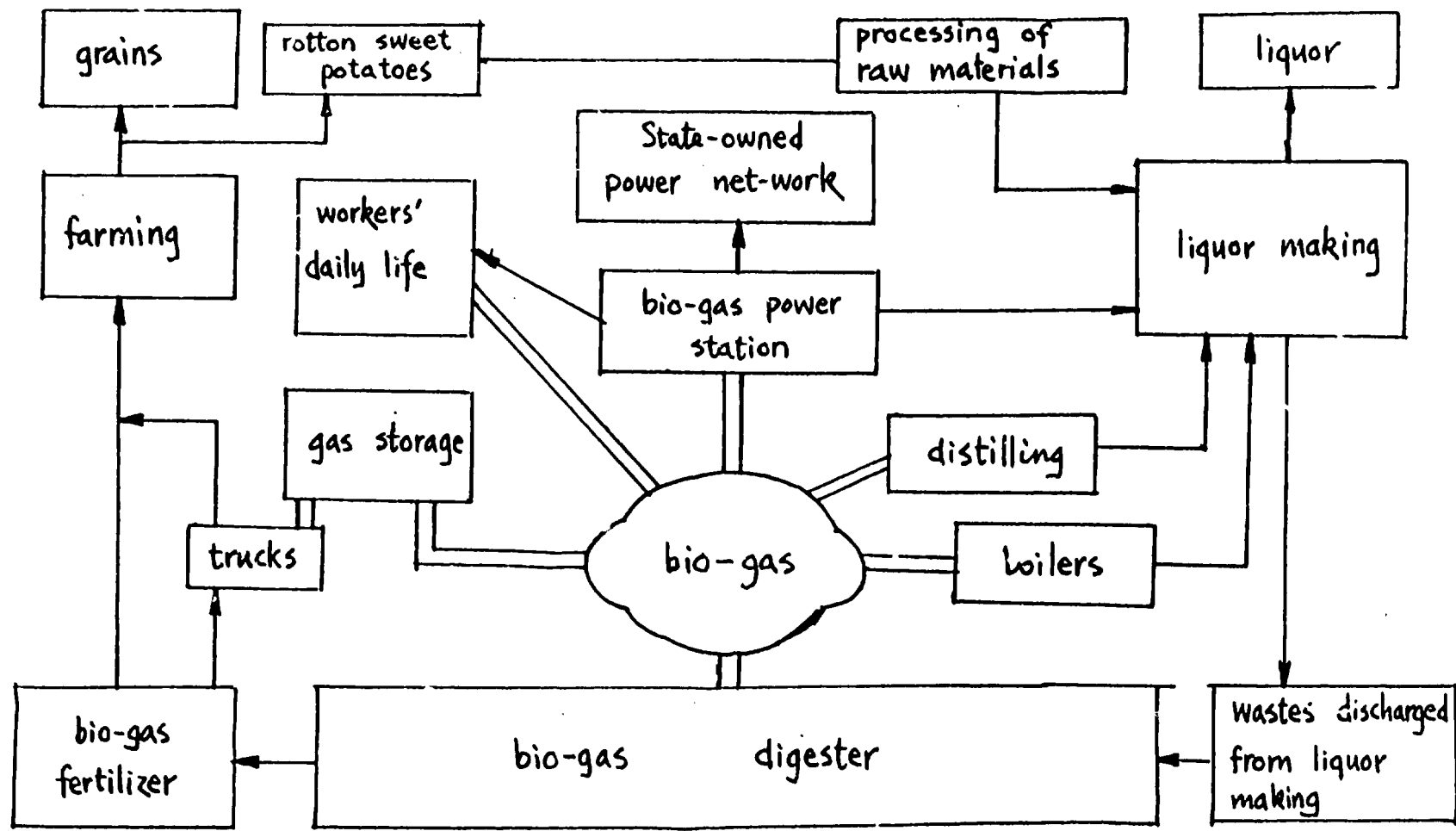
In order to make even better use of bio-gas, another 120 kw diesel-power generator set was installed and started operation in May this year. Working alternatively, the two generator sets can generate power round the clock and operate in a full-load mode. Surplus electricity produced by these two generators are fed into the State-owned power network. In addition, an 800 m³ bio-gas storage has been constructed and is in operation now. At night the unused bio-gas is stored in this container, and then compressed into oxygen cylinders and gas bags for the purpose of driving trucks. The 240 m³ of bio-gas compressed into the 16 oxygen cylinders can drive a truck to a distance of 720 kilometers. This reduces substantially the cost of transporting bio-gas fertilizer to the countryside.

A complete re-circulation system of organic matter for the comprehensive utilization of bio-gas has been formed in this distillery, as illustrated by the diagram. The enhancement of scientific management will result in even greater benefits in the future.

Progressing towards a Greater Goal

Though the Rongxian County Distillery has obtained some benefits from the comprehensive utilization of bio-gas, this is only the beginning of a long march. They are now faced with several problems which must be solved in practice.

(1) How to make full use of the rich raw materials for bio-gas fermentation. At present, raw materials for bio-gas fermentation discharged from the distillery are only kept in the digester for 7 to 10 days for fermentation and gas production, counting from the day of feeding to the time of withdrawal of fermentation materials. Many bubbles and foams can be seen at the outlet of the digester, and this



Block Diagram Illustrating the Comprehensive Utilization
Of Bio-Gas By Rongxian County Distillery in Sichuan

indicates that gas production is just at its peak. The workers are very sorry that they have to withdraw the half-used materials to make room for new materials. They are planning to build another 2000 m³ bio-gas digester or prolong the circulation path of the existing U-shaped digester so as to increase fermentation time. They will also conduct tests on gas production rates in hopes of finding a way to double gas yield with the present facilities.

(2) How to increase the utilization ratio of bio-gas. Bio-gas is used with a low efficiency in the distillery, and burning bio-gas to heat the boilers, in particular, is a great waste. The workers plan to improve operation procedures and the burner structure as preliminary measures. At the same time, they want to install two more generating sets of the same type so that burning bio-gas only for power generation will be possible. In this way, the bio-gas utilization ratio and power generating capacity can be increased and the cost of electricity can be reduced, thus making even greater contributions to the State. And this will also help to realize the electrification of the production of the distillery and enable the workers to use more electric devices in their daily life.

Up to now more than 390,000 yuan has been invested in the exploitation of bio-gas in the Dongxian County Distillery. Based on things as they stand now, one can make the following calculations. With the two power generating sets in operation day and night, 800,000 kw-hr of electricity can be provided in a year, which amounts to a sum of more than 56,000 yuan. In using bio-gas as truck fuel, 48.6 tons of fuel, which values more than 36,000 yuan, can be saved in a year. In using bio-gas for production and daily life, 507 tons, or more than 11,000 yuan's worth of coal can be saved every year. When put together, these three sums of money exceed 100,000 yuan. It will therefore only take 3 or 4 years to recoup all the investments. With

their management technique improved and the bio-gas related capital construction expanded and perfected this distillery is bound to obtain even greater benefits from the comprehensive utilization of bio-gas. The exploitation of bio-gas has a very bright future.



