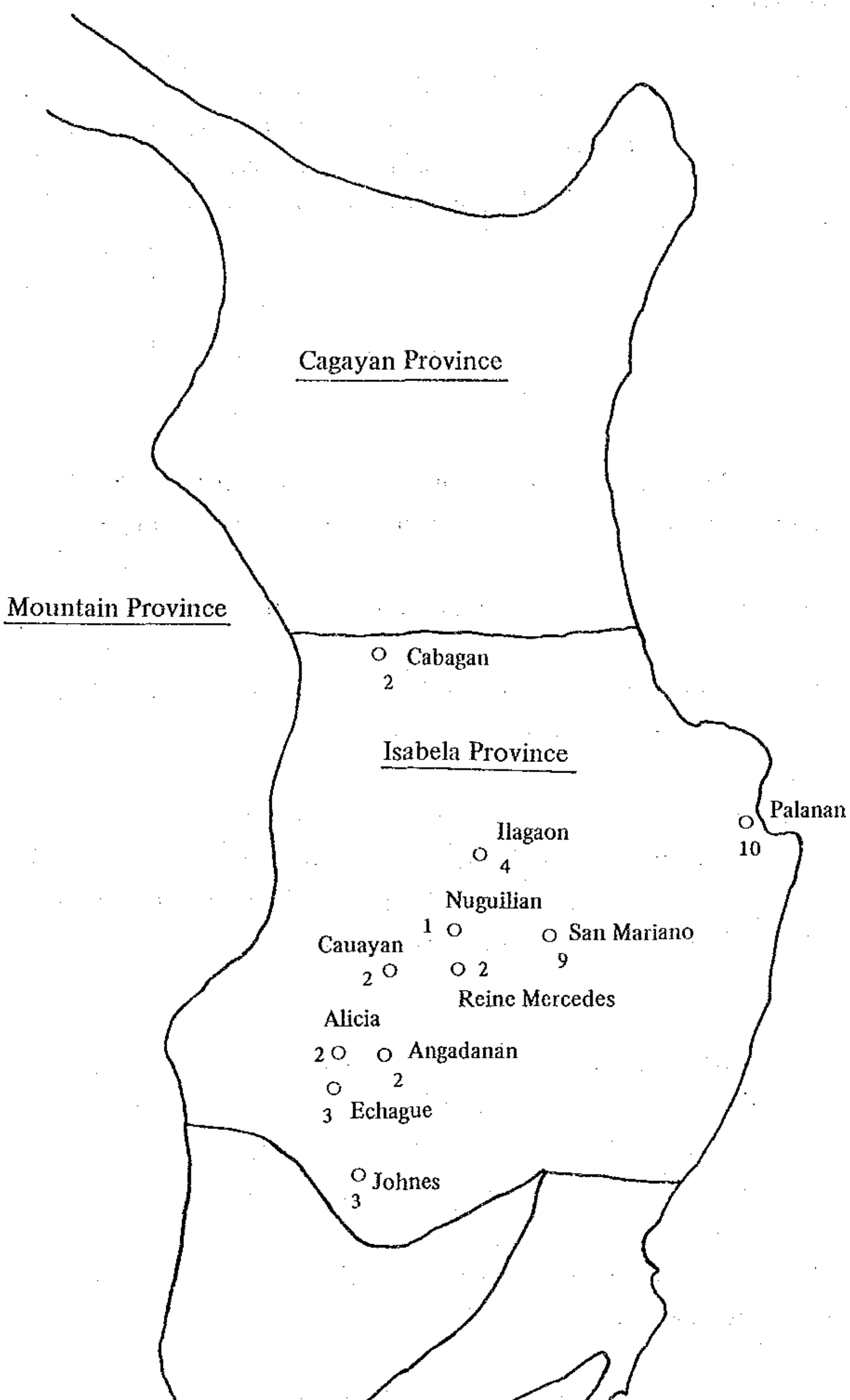
Fig. 7-3. ISABELA PROVINCE



be transported to Manila when it is exported or sent to domestic markets. Hence, it is economically disadvantageous to set up a powdered activated carbon manufacturing plant in Isabela Province.

In spite of the availability of lots of sawdust in Isabela Province, it will be unprofitable to establish an activated carbon manufacturing plant in this province due to above reasons.

7.4.5 Metro Manila

		Existing sawmills	Daily Rated Capacity (1,000 BFD/D)	Annual Log Requirement (1,000 m^3)	Active sawmills	Lumber Production (1,000 m^3)
Metro Manila	1981				14	52
	1982	34	850	808	14	98

The operation of sawmills in 1981 and 1982 is shown in the above table, which indicates that the operation was rather inactive.

The wood species being sawed in Metro Manila is mainly Apitong coming from Palawan Island, and also Lauan coming from Isabela Province is being used.

The generation ratio of sawdust in the sawmills is about 15% of the quantity of processed wood, and most of which is left without being used.

Pretty much sawdust is being generated, but the majority of sawmills in this area are using the American method, in which water is used to cool the band saw as in Isabela Province. Consequently, the sawdust thus generated contains much water, and must be dried before being used to manufacture powdered activated carbon. This makes the operation of the activated carbon plant uneconomical.

7.4.6 Camarines Norte Province

		Existing sawmills	Daily Rated Capacity (1,000 BFD/D)	Annual Log Requirement (1,000 m^3)	Active sawmills	Lumber Production (1,000 m^3)
Camarines Norte	1981				5	9.6
	1982	9	195	201	2	0.9

The operation of sawmills in 1981 and 1982 is shown in the above table. Recently, the cutting of trees was restricted, and in 1982 only two sawmills were operated and the operation rate was low.

In Bicol area coconut forests are generally predominant, and sawing is not actively done. Even in Camarines Sur out of the 8 sawmills, only three are being operated.

The wood species being used for sawing in this area are Red Lauan and White Lauan and Mayapis. But they are small in quantity.

The ratio of sawdust generated in the sawmill is about 15% of the processed log, and the sawdust is left outside of the sawmill without being utilized.

The situation being like that, it is unable to obtain sufficient quantity of sawdust in this area.

7.4.7 Laguna Province

Laguna Province is originally not active in sawing wood, and there is no sawmill under operation at present.

However, in Laguna Province there are two large factories such as Soriano Fiber Industries and Coirflex Philippines Inc. in S. Pablo City which are producing coir fiber from the husk of coconuts. Therefore, investigations were made on the generation of coir dust.

These two factories are putting out 650 kg/day and 1,800 kg/day of coir fiber respectively with one shift operation, and coir dust is generated as much as 1.5 times the quantity of coir fiber. This means that they are wasting about 1,000 kg/day and 2,700 kg/day of coir dust respectively.

In producing coir fiber, there are two methods, wet and dry. The coir dust generated in Soriano Fiber Industries, which is adopting the wet method, contains much water, and is unsuitable for manufacturing powdered activated carbon from it even if the dust is gathered.

In manufacturing one ton (bone dry) of powdered activated carbon, it needs 16 tons (bone dry) of coir dust. Accordingly, the quantity of coir dust cited above is quite insufficient for the production of activated carbon even if the whole quantity could be gathered.

7.4.8 Others

The operation of sawmill fluctuates depending on the rainy or dry season as well as on the economic situation. Therefore, the condition around the area concerned must be fully taken into consideration when investigations are made regarding the quantity of sawdust available.

Chapter 8

BASIC CONCEPT OF THIS PROJECT

Chapter 8. BASIC CONCEPT OF THIS PROJECT

Several items relating to this project have already been explained in the preceding chapters. In this chapter, a description is given of the basic concept of this project that serves as the basis for the various studies made in the following chapters.

8.1 Raw Materials

Raw timber, waste wood and waste of lauan, ipil-ipil, falcata, apitong, kakauate and coir dust are technically usable as the raw material for manufacturing powdered activated carbon of this project. However, as observed from the aspects of economy and procurement, the use of only sawdust as the raw material is recommended as pointed out in Chapters 4 and 7.

Sawdust is being generated in sawmills in various regions, and, excepting for sawmills which are utilizing sawdust for the manufacture of processed commodities, virturally the entire volume of sawdust generated today is being burnt or disposed of without being utilized, causing environmental pollution problems in some of these regions.

The kinds of raw timber processed by sawmills differ according to the mill's location, situation of procurement of raw timber and other factors, but in the Philippines more than 80% of processed raw timber is lauan and less than 10% consists of apitong. In view of this situation, the larger proportion of sawdust available in the country consists of lauan and only a small portion consists of apitong.

If an appropriate site is selected for the plant, sawdust, consisting primarily of lauan, sawdust can be obtained free of charge.

Meanwhile, as pointed out in Chapter 5, findings of tests conducted with various kinds of sawdust have corroborated that powdered activated carbon produced from lauan-based sawdust reveales excellent properties.

Based on these observations, the conclusion is that sawdust is the most optimum raw material for the manufacture of powdered activated carbon in this project. Accordingly, sawdust currently being disposed of by sawmills shall be used as the raw material for this project.

8.2 Product Market and Production Scale

The larger the production scale, the less will be the fixed cost per ton of product, resulting in lower manufacturing costs. On the other hand, due consideration has to be given to the product's market situation when determining the production scale.

The market situation is as described in detail in Chapter 6.

Conceivable sales markets for the product are the domestic market and foreign markets. This project is the very first venture in the Philippines for manufacturing powdered activated carbon by using sawdust as the raw material. It is true that domestic and foreign markets do exist for the product, but it is also true that there is no commercial experience of having marketed powdered activated carbon product.

Accordingly, in order to gain market acceptance for the product, it will be necessary to conduct sales promotion activities in order to develop and expand markets for the product. Without these activities, expansion of sales volume cannot be expected, but with ample sales promotion, a domestic sales volume of about 160 tons appears possible as pointed out in Chapter 6.

However, for the time being, it would be safer to estimate the domestic sales volume at about 120 T/Y.

Meanwhile, regarding foreign markets, markets are conceivable in Thailand, Indonesia and industrially advanced countries such as Japan. Among these foreign markets, large potential markets exist in Japan.

With industrially advanced countries, the market size will be influenced decisively by the business conditions. As the world economy is still lying in a recessive mood, market demands for activated carbon are not necessarily brisk for the moment. So placing great expectations on foreign market sales volumes would be inadvisable as observed from the stability of the enterprise. Especially since there is no corporate experience yet in product sales, estimating overseas sales volume potentials conservatively would be more appropriate.

Meanwhile, when giving thought to corporate stability, it will be necessary to sell considerable amount of the product on the domestic market excepting the case of a joint venture with foreign investors in which most of the product is taken over by the foreign investors.

Based on this line of thought, the plan for this project shall be to retain about one fourth of the manufactured product for the domestic market and to sell the surplus to foreign markets. And in view of the size of the domestic market as described in Chapter 6 and of minimum economic scale of the plant, the optimum scale of the plant is conceived to be 40 T/M, or 480 T/Y.

Therefore it is planned to retain one fourth of the plant's output, or 120 T/Y, for the domestic market, and to sell the remaining 360 T/Y on foreign markets.

Regarding procurement of the necessary volume of raw material sawdust corresponding to this scale of production, no problem is anticipated on condition that Davao would be selected as the plant site.

8.3 Plant Site

As described in Chapter 7, it will be the most economical to utilize the sawdust, which is being disposed of by sawmills, as the raw material for manufacturing powdered activated carbon of this project.

In this respect, the survey team in its first stage field survey conducted a survey of various regions in the Philippines primarily in connection with waste sawdust volume available,as described in Chapter 7. In this survey, the physical properties of the sawdust and types of raw timber of the sawdust were studied. Survey was also made on the availability of timbers other than lauan and of coir-dust which were selected as objects of the tests.

Based on these survey findings and various other observations, the preliminary judgement was that the Davao region would be the optimum plant site.

Next, in the second stage field survey, a detailed survey was conducted primarily with the aim of finding out specific candidate plant sites in the Davao region and of confirming that these candidate sites would pose no problem in aspects of plant construction.

As a result, several places in the Davao region were judged to be free of any problems as the plant site for this project.

8.4 Scope of Plant

When manufacturing steam activated carbon, refined powdered activated carbon can be obtained by providing adequate facilities for all the processes of carbonization, activation and refining.

However, a study of the market structure in the Philippines shows that only a small demand exists for refined powdered activated carbon and that the domestic market consists almost entirely of demands for unrefined product, so the provision of refining facilities at this stage would be uneconomical. Accordingly, the scope of the plant for this project shall consist only of the carbonization plant and activation plant, without a refining plant.

Incidentally, in this project, after-burners are installed in the carbonization plant for minimal discharge of smoke into the atmosphere from the plant.

Regarding the future plans, it is recommended that, in the event the market expands for the present plant's product, the construction of a new plant is planned, after fully confirming that necessary volume of raw material sawdust would be available at a moderate price when the production volume is increased by the construction of the new plant.

In this case, there is a great possibility of the new plant to be constructed at a site different from that of the plant of this project. There is also the possibility that when expanding the plant of this project, the carbonization plant may be constructed at a different site, depending on the conditions for procuring the necessary raw material sawdust.

When planning the construction of the new plant, the feasibility of constructing a refining plant will have to be given due study. In this case, study will have to be given especially to the following items:

a) Whether the market for refined activated carbon is large enough.

b) Installing a waste water treatment facility meeting local environmental pollution regulations.

c) Profitability of the refining plant equipped with a waste water treatment facility.

8.5 Manufacturing Process Selected

Regarding the manufacture of powdered activated carbon, joint basic research has been in progress since 1976 between GIDLH and NIST. The process selected for research was the powdered activated carbon manufacturing process based on the steam activation process and using sawdust as the raw material, in which the open hearth process was adopted for carbonization and the circular fluidized bed process for activation.

The same manufacturing processes have been adopted even in the tests conducted in the compounds of NIST since January 1984 by means of a small-scale plant.

For the reasons described above, it is preferable that the same processes that have been adopted for conducting basic research and manufacturing tests would be selected. Regarding this matter, a more detailed description will be given in Chapter 9.

Therefore, when calculating the funds necessary for this proejct, the estimate was made on the assumption that the following processes would be adopted:

a) Carbonization .... Open hearth process
b) Activation .... Circular fluidized bed process

8.6 Selling Price

1) Selling Price for the Domestic Market

On the domestic market, the market price of the product manufactured through this project should be same or lower than that of the imported powdered activated carbon available on the market.

As described in Chapter 6, the domestic market price of imported powdered activated carbon (steam activation process), including import duty, is estimated to exceed US$2,000/T.

When the product manufactured through this project is sold a sales tax of 10% is levied, and when selling the product in Manila, for example, the transportation cost between Davao and Manila will have to be added. By taking all these factors into account, the ex-factory price of this product for the domestic market is set at US$1,600/T. Then, the price of the product at Manila will be about US$1,800/T, which is considered to be competitive.

2) Selling Price for Foreign Markets

Japan is the largest export market. When exporting the product manufactured through this project to Japan, the product will have to compete with the same kinds of powdered activated carbon products which are being imported into Japan.

When selling this product, a 10% sales tax is levied, and the transportation cost from Davao to Japan should be added.

If the product's ex-factory price is set at US$1,200/T, the price of the product at the Japanese market will be about US$1,570/T. This is higher than that of the powdered activated carbon currently being imported by Japan from neighboring countries. However, since the product manufactured through this project features a high M.B. value of 190–200 at 25% char yield, the product is observed to be competitive. Therefore, the ex-factory price for export is set at US$1,200/T as described in chapter 6.

Incidentally, the mean weighted ex-factory price of the product for the domestic market and for the export market is US$1,300/T as of September 1984.

8.7 Price Escalation

As described in Chapter 14, the mean annual price escalation rate in the Philippines in US$ equivalent is about 3%. Meanwhile those in Japan and other industrially advanced countries are 3% and a little more than 5%, respectively. Similar rates are projected for future. Therefore, it will be most appropriate to assume the future annual price escalation rate at 5%.

In the feasibility study of this project, the prices and costs as of September 1984 were first estimated. Next, these prices and costs were escalated by using the above-mentioned escalation rate, and a financial evaluation of the project was made by using the prices and costs thus obtained.

8.8 Incentives Available for This Project

This project is eligible for incentives as a pioneer industry. In addition, incentives are also given to an export venture. As a result, in this project the corporate tax will be nil for a period of five years from the time of commencement of plant operation.

Chapter 9

MANUFACTURING PROCESS AND PRODUCTION SCALE

Chapter 9. MANUFACTURING PROCESS AND PRODUCTION SCALE

9.1 Manufacturing Process

Several processes are available for manufacturing powdered activated carbon by using sawdust as the raw material. The most widely accepted of these processes are the following:

* Chemical activation process (zinc chloride activated carbon, phosphoric acid activated carbon).

* Gas activation process (steam activated carbon, carbon dioxide gas activated carbon).

With the former process, raw material sawdust is impregnated with zinc chloride or phosphoric acid and heated to a temperature of 500–650°C, by which cellulose existing in the raw material dissolves into zinc chloride or phosphoric acid solution. It is further carbonized in liquid state to create fine pores in the process of generation of carbon.

Meanwhile, with the gas activation process, sawdust is carbonized to produce char. It is then activated at a high temperature of 800–1,000°C by reaction of steam or by reaction of a mixed gas consisting of steam and carbon dioxide generated by sawdust char combustion.

The principal reactions involved in the activation process are the following endothermic reactions:

$$C + H_2O \rightarrow CO\ (\text{or } CO_2) + H_2 - Q_1,$$

$$C + CO_2 \rightarrow CO - Q_2.$$

Fine pores are formed in the char in the process of these reactions. And in order to continue these endothermic reactions, the required quantity of heat for these reactions will have to be supplied from some external source.

Activation furnaces are available in either of two types --- the externally heated type and the internally heated type.

The externally heated type furnace is not being accepted widely for producing powdered activated carbon owing to its low thermal efficiency and productivity as well as problems in the furnace's heat resistivity.

With the internally heated activation furnace, certain quantity of heat to be required for continuing the carbonization reaction is supplied by combusting the char in the reaction system.

When manufacturing powdered activated carbon by the steam activation process in Japan, in virtually all cases, air, steam and exhaust gas from activation furnace are blown into the furnace as a means of combusting part of the raw material with air, and certain quantity of heat required for activation is supplied by the combustion heat generated by the following reaction:

$$C + O_2 = CO_2 \text{ (or CO)} + Q_3.$$

The thermal efficiency is much higher with the internally heating process than with the externally heating process.

Among internally heated furnaces, such furnaces as upright type fluidized bed furnace, lateral type fluidized bed furnace, suspended state furnace are known.

However, in this project, it is aimed to manufacture powdered activated carbon by constructing a commercial scale plant based on the results of basic R&D conducted over several years and on the results of tests conducted by means of a test plant in 1984, under close cooperation between the Japanese Government and the Philippines Government.

Accordingly, the process to be adopted in this project should preferably be the same process that had been adopted in the basic R&D, and test plant.

The process adopted in the test plant consists of the open hearth carbonization process for carbonization, and the steam activation process based on the circular fluidized bed furnace for activation.

The principal characteristics of these processes may be summarized as follows:

1) Carbonization Process

The open hearth type carbonization furnace is adopted for carbonization. This type of furnace can be applied to various kinds of raw materials, its operation is accomplished with ease as long as know-how is acquired, and char of stabilized properties can be produced.

In the Philippines, the adoption of the open hearth type furnace that enable employment of many workers will rather be more desirable than a carbonization furnace designed for labor saving operation through sophisticated mechanization. As the labor cost is low, the adoption of the open hearth type carbonization furnace is also conceived to be more advantageous in economic aspects.

Incidentally, with the installation of after-burners, it is possible to minimize the exhausting of flue gas to outside.

2) Activation Process

In the steam activation process, the water gas reaction is accomplished at a high temperature. Though various different types of systems have been developed, in this project, the circular fluidized bed type activation furnace is adopted that was based on Japanese patents, and it has been improved successively over a period of 20 years.

The principal characteristics of this furnace may be summarized as follows:

a) This furnace features a compact structure, low construction cost and easy maintenance.

b) The furnace is adequately applied for all kinds of raw material char having a wide range of particle size distribution, and produces activated carbon of good and stable quality.

c) Tests on the manufacture of powdered activated carbon using Philippine sawdust as the raw material have already been conducted at the test plant. Although enlarging the scales of equipment which involve chemical reactions at high temperatures is not easy generally, in this case, no problem is anticipated in its scale enlargement since past achievements have already confirmed the possibility.

d) No combustion supporting fuel whatsoever is used in the activation process.

Since a heat recovery system is provided, it will be possible to divert surplus heat to other purposes.

e) The furnace is started and stopped with ease, and stable operation is attained in a short period of time.

9.2 Production Scale

As described in Chapter 8, the powdered activated carbon output of this project was set at 40 tons/month as judged from the raw material situation and potential market demand.

As for the manufacturing system for char production, open hearth type carbonization furnace, which is low in cost and requires a large labor force, was adopted as described earlier, and for activation, steam activation process based on circular fluidized activation furnace was adopted.

Described hereunder is the production scale of manufacturing sawdust char by the open hearth process and the production scale of manufacturing activated carbon by the steam activation process.

9.2.1 Manufacture of Char by Open Hearth Process

In the manufacturing system adopted for this project, raw material sawdust will first have to be carbonized to produce char.

Sawdust char is manufactured by using open hearth type furnaces having inner dimensions of 2.4 m x 5.4 m x 0.6 m (depth). The carbonization capacities of these furnaces will differ dependent on the properties of the sawdust carbonized, but in general a furnace is capable of producing 600 kg (bone dry) of char on the average in a manufacturing period of 4 days.

Since 4 tons of char (bone dry) will be necessary for manufacturing 1 ton of powdered activated carbon, 160 tons/month of char will be necessary for manufacturing 40 tons/month of powdered activated carbon.

Assuming that the plant is operated for 25 days/month, the number of furnaces necessary for manufacturing 160 tons/month of char, will be as follows:

160 tons/month ÷ 0.6 ton ÷ 25/4 ≑ 43 furnaces.

However, for the benefit of a slight margin of tolerance, the number of furnaces has been set at 44 units.

Though the production capacity per unit of open hearth furnace is comparatively small, by increasing the number of furnaces corresponding to the production scale, no particular problem is raised for producing 40 tons/month of powdered activated carbon.

9.2.2 Manufacture of Activated Carbon by Steam Activation Process

In this project, the steam activation process based on the circular fluidized activation furnaces is adopted for activation of sawdust char.

The activation furnace is a facility for manufacturing activated carbon continuously, and while its capacity will be influenced slightly by the kind of raw woods and property of the raw material sawdust, in general the capacity of each unit will run up to 15–20 tons/month/unit.

In order to manufacture 40 tons/month of powdered activated carbon, three activation furnaces will have to be installed in view of the need of stopping a furnace for regular inspection and maintenance work.

Therefore, regarding these activation furnaces, there is also no technical problem to be encountered in the manufacture of 40 tons/month of powdered activated carbon.

9.2.3 Post-Activation Processes

Activated carbon after activation process is passed through the processes of crushing, blending and packing before being shipped out.

The facilities for these post-activation processes may appear a little bit excessive with respect to the production capacity of 40 tons/month of powdered activated carbon, but since they do not cost so much and when taking into consideration future expansion of production, they cannot be conceived to place a large burden on this project.

Depending on the specific application of the powdered activated carbon, the activated carbon may have to be refined subsequently to crushing for shipment as the final product. But as pointed out in Chapters 6 and 8, the existing demand for refined powdered activated carbon in the Philippines is still very limited, and even when considering the export of refined products to foreign markets, the range of applications will be highly diversified, resulting the introduction of diversified products/small lot production system. This production system will raise manufacturing costs to relatively high levels with the provision of expensive facilities, so in this project no refining facilities are installed.

It is desirable that the economy of installing the facility will be restudied in the future when the demand for refined products increases.

9.3 Manufacturing Facilities

The following manufacturing facilities will be necessary for producing powdered activated carbon.

9.3.1 Carbonization Section

No.	Name	Q'ty	Specification
1	Carbonization Furance	44	2,400W x 5,400L x 600H, Open hearth type
2	After Burner Furnace	3	
3	Burner	3	10–30 ℓ/hr., Gun type, 0.2 kW
4	Stack	3	400 ϕ x 20,000H, SUS
5	Pneumatic Conveyor Blower	1	120 m^3/min., ΔP 400 mmAq., 18 kW
6	Cyclone	1	600 ϕ x 3,000 L, SS, with Rotary Valve, 0.4 kW
7	Bag Filter	1	2,000W x 4,000L x 5,000H, SS
8	Cooler	1	Screw type, SS, 0.75 kW
9	Conveyor	1	400W x 5,000L, Belt type, 2 kW
10	Switch Board	1	
11	Platform Scale	2	50 kg

9.3.2 Activation Section

No.	Name	Q'ty	Specification
1	Hopper	3	2,000W x 1,500L x 2,000H, 5 m^3, SS
2	Screw Feeder	3	With Adjustable Speed Motor, 0.75 kW
3	Activation Furnace	3	1,200W x 6,700L x 2,500H, Fire Brick
4	Boiler	3	7.5 m^2, 5 kg/cm^2, SB, 225 kg/hr., 0.4 kW
5	Water Softener	1	Ion Exchange type, 4 t/hr. Max.
6	Water Tank	1	2,500 ϕ x 2,200H, 10 m^3, SS
7	Circulating Blower	3	20 m^3/min., ΔP 400 mmAq., 3.7 kW, SS
8	Main Blower	3	30 m^3/min., ΔP 400 mmAq., 5.5 kW, SS
9	Air Blower	3	5 m^3/min., ΔP 200 mmAq., 0.75 kW, SS
10	Cyclone	3	With Rotary Valve, 0.4 kW, SS
11	Cyclone	6	2ry
12	Switch Board	1	With Temperature Recorder
13	Platform Scale	2	50 kg

9.3.3 Crushing Section

No.	Name	Q'ty	Specification
1	Pneumatic Conveyor Blower	1	30 m^3/min., ΔP 380 mmAq., 3.7 kW, SS
2	Cyclone	1	300 ϕ x 1,200H, SUS, with Rotary Valve, 0.2 kW
3	Hopper	1	3,000W x 2,000L x 4,200H, 30 m^3, SS

No.	Name	Q'ty	Specification
4	Screw Feeder	1	200 ϕ x 3,500L, SS, 1.5 kW
5	Pulverizer	1	300 kg/hr., SS, 22.6 kW
6	Pneumatic Conveyor Blower	1	30 m^3/min., ΔP 380 mmAq., 3.7 kW, SS
7	Bag Filter	1	40 m^2, with Rotary Valve, 0.4 kW, SS
8	Control Panel		

9.3.4 Mixing and Packing Section

No.	Name	Q'ty	Specification
1	Bag Filter	1	40 m^2, with Rotary Valve, 0.4 kW, SS
2	Mixer	2	2,000 ϕ x 3,000H, 9 m^3, with Agitator, SUS, 3.7 kW
3	Blower	2	2 m^3/min., 0.5 kg/cm^2, with Oil Mist Separator, 3.7 kW
4	Neutralizer	2	0.4 kW
5	Dust Collector	1	12 m^2, 20 m^3/min., SS, Bag Filter type, 1.5 kW
6	Platform Scale	2	50 kg
7	Sewing Machine	1	200 sacks/hr., 0.8 kW
8	Conveyor	1	350W x 20,000L, Blet type, 1.5 kW
9	Switch Board	1	
10	Air Compressor	1	0.7 m^3/min., 7 kg/cm^2, 5.5 kW

9.4 Processes Flowsheet

Figs. 9-1 and 9-2 show the process flowsheets for the manufacture of powdered activated carbon.

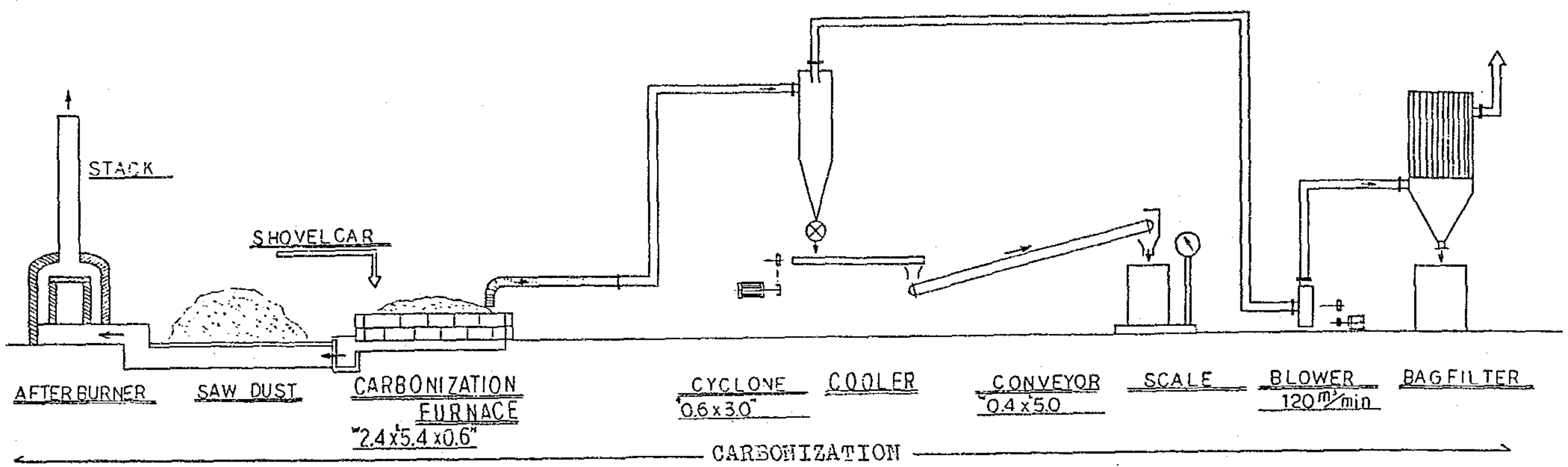


Fig. 9-1

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

CARBONIZATION PLANT
FLOW SHEET

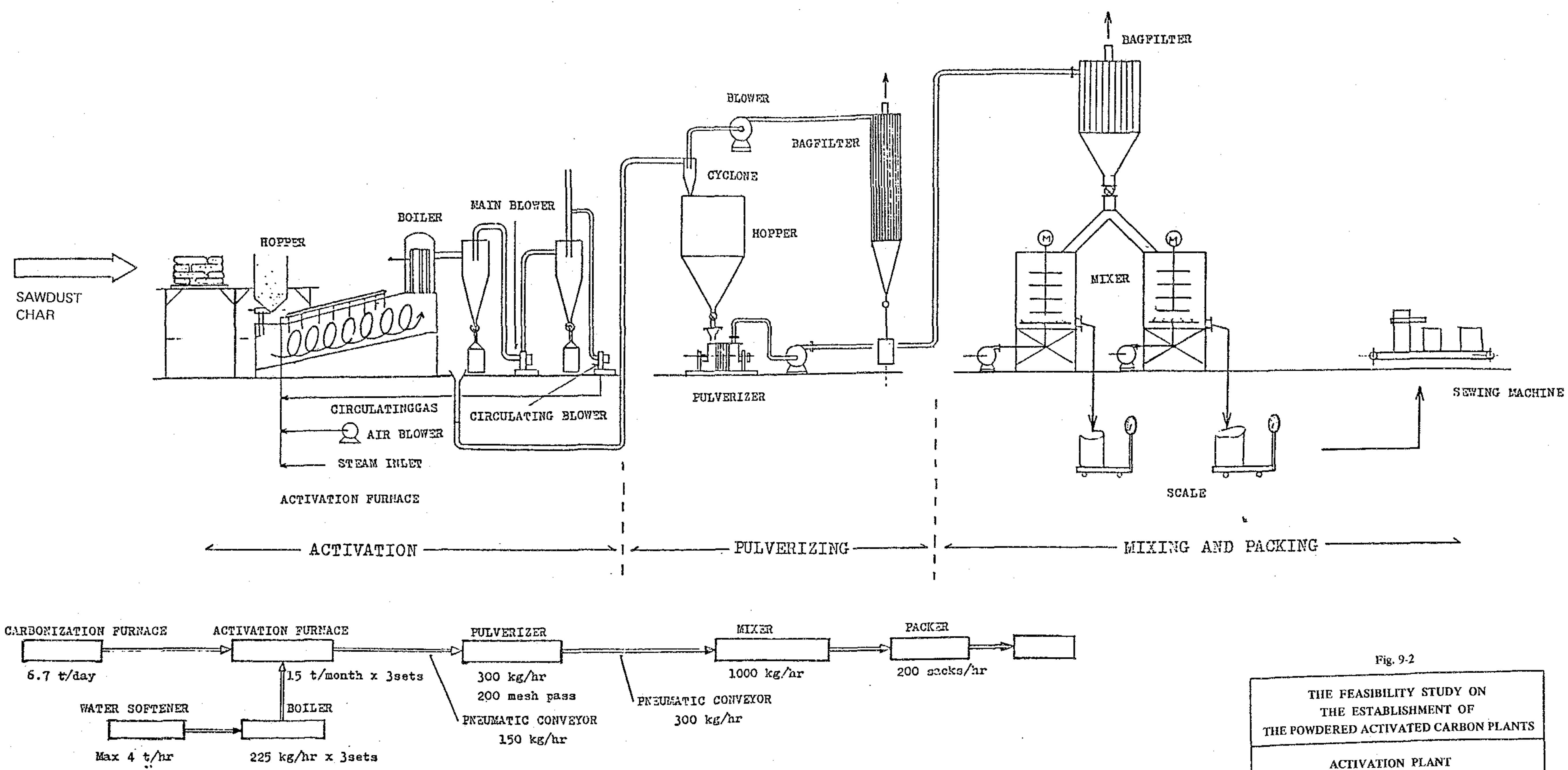


Fig. 9-2

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

ACTIVATION PLANT
FLOW SHEET

Chapter 10

CONSUMPTION OF RAW MATERIALS AND UTILITIES

Chapter 10. CONSUMPTION OF RAW MATERIALS AND UTILITIES

As described in Chapter 9, the powdered activated carbon manufacturing process of this project starts out from collection of raw material sawdust, followed with carbonization of sawdust, activation of sawdust char, and ends with the crushing and blending of activated carbon produced.

The raw materials and utilities consumed in the process of manufacture of powdered activated carbon are sawdust, sawdust char, electricity, water and packing bags. The consumption rates of these raw materials and utilities will be as described hereunder.

10.1 Sawdust

The sawdust used in the manufacture of powdered activated carbon is collected from sawmills, then carbonized in the carbonization plant into sawdust char.

According to findings of the test team, 4 tons of sawdust (bone dry) will be required for producing 1 ton of sawdust char (bone dry). The test team has also confirmed that 1 ton of powdered activated carbon can be produced from 4 tons of sawdust char (bone dry). Therefore, 16 tons of sawdust (bone dry) will be required for producing 1 ton of powdered activated carbon.

Since the production scale of this project is determined at 40 tons/month, the monthly consumption of sawdust will run up to 640 tons (bone dry)/month.

The sawdust used in this project consists primarily of sawdust generated in the process of sawing lauan timber. The bulk density is roughly 0.23 ton/m^3. The volume of sawdust required monthly runs up to:

$$640 \div 0.23 \doteqdot 2,800 \text{ m}^3/\text{month}.$$

Incidentally, the properties desirable for sawdust used as the raw material for manufacturing powdered activated carbon will be as follows:

a) Sawdust whose particle size distribution rather lies toward the coarser side, or over 45–50% of which would have a size exceeding 28 mesh when put to screening test.

b) Sawdust containing minimal mixtures of soil and sand, wood chips and other foreign substances.

10.2 Sawdust Char

Sawdust char is an intermediate product in the process of powdered activated carbon production. As described in Paragraph 10.1, 160 tons (bone dry)/month of sawdust char will be required for this project.

Sawdust char is activated in order to produce powdered activated carbon, for which the following properties will be desirable for sawdust char:

a) Moisture Content

Moisture content of 8–12% will be desirable. Excessive moisture will make char feeding impossible owing to bridging in the feed hopper when sawdust char is fed into the activation furnace. Troubles such as lowering of activation furnace temperature may also arise. On the other hand, an excessively low moisture content will result in the generation of much dust in its handling.

b) Volatile Matters

Volatile matters content of 28–38% will be desirable. A certain extent of volatile matters content will provide better activation results than an excessively low volatile matters content. However, sawdust char containing reddish brown uncompletely carbonized particles will be undesirable even if it contains high volatile matters.

c) Particle Size

The sawdust char's particle size will depend on the properties of raw material sawdust that is used. A coarse particle size distribution will be desirable, and char having more than 55–60% of particles of over 48 mesh as confirmed through a screening test may be considered as comparatively coarse char.

d) Bulk Density

This will be dependent on the raw material sawdust that is used. With lauan, the bulk density will be 180–240 kg/m^3. With sawdust char obtained from the same kind of timber, one having a smaller bulk density will be easier to activate.

10.3 Electricity

The installed capacity of the proposed powdered activated carbon plant is roughly 100 kW, and the principal facilities consuming electricity are the blowers, crushing machine and compressor.

The unit consumption of electricity is 500 kWh/ton, so the monthly consumption of electricity for manufacturing will run up to 20,000 kWh.

10.4 Water

Water consumed by the powdered activated carbon manufacturing facility is primarily for the boilers and for sawdust char fire extinguishing in the carbonization process. The unit consumption of water being 20 m^3/ton, the monthly water consumption will run up to 800 m^3.

10.5 Packing Bags

Two types of packing bags are used – one for sawdust char and the other for powdered activated carbon product.

10.5.1 Packing Bags for Sawdust Char

The bags are used for storing sawdust char temporarily, and the sawdust char filled in these bags are subsequently fed to the following activation process.

Normally, polyethylene or vinyl chloride bags capable of containing up to about 15 kg of sawdust char (bone dry) are used.

Since the storage of about 4 days' equivalent of sawdust char will be necessary, and assuming that the plant is operated for 25 days/month, the number of required bags will be as follows:

$$40 \text{ tons/month} \div 25 \text{ days/month} \div 0.015 \text{ ton/bag} \times 4 \text{ days} \times 4$$
$$\doteqdot 1{,}700 \text{ bags}$$

These bags are used as the delivery bags in the plant and since their annual damage rate runs up to be small, their supplementation cost will be negligible.

10.5.2 Bags for Product

Powdered activated carbon finished into commercial product in the final crushing and blending process is pack-in 20 kg units into the product bags for shipment. This bag consists of the inner and outer bags. The inner bag is made of 2-ply kraft paper and so designed as to purge the air existing among activated carbon particles when the temperature in the bag rises. Meanwhile, the outer bag is made of 3-ply kraft paper, among which one of these layers is made of polyethylene laminated sheet to prevent infiltration of water from the outside.

The required number of product bags will be as follows:

$$40 \text{ tons/month} \times 12 \text{ months} \div 20 \text{ kg} = 24{,}000 \text{ bags/year}$$

In addition, product bags equivalent to one month's stock of product for sales will be necessary, or

$$40 \text{ tons/month} \div 20 \text{ kg} = 2{,}000 \text{ bags}$$

10.6 Kerosene

Discharging the exhaust gases of carbonization furnaces and activation furnaces into the atmosphere without any treatment may cause environmental pollution, so in this project, after-burners are provided to pre-treat exhaust gases.

These after-burners consume kerosene at a rate of 150 liters/ton-product.

10.7 Summary

Table 10-1 compiles the cost factors described above.

Table 10-1 CONSUMPTION OF RAW MATERIALS, SUPPLIES & UTILITIES PER TON OF PRODUCT

	Consumption per Ton of Product	Unit Price (₱)
Sawdust (gasoline)	35 ℓ	8.37
Electricity	500 kWh	0.69
Bag (for sawdust char)	9 bags	8.0
Bag (for product)	50 bags	30
Kerosene (for after-burners)	150 ℓ	8.37

For details, please refer to Appendix 10A-1.

Chapter 11

PLANT SITE

Chapter 11. PLANT SITE

11.1 General Description

The plant site has to be selected by taking into consideration numerous factors — technical, economic and social. The most vital factor for selecting the plant site for this project is the procurable volume of raw material sawdust.

The manufacture of powdered activated carbon requires 16 tons of bone-dry sawdust for obtaining 1 ton of product. That is, since a huge quantity of raw material is required for producing a small quantity of product, the selected plant site must enable procurement of ample supplies of raw material with ease and at low transportation cost.

The study team investigated various candidate plant sites with these factors taken fully into account.

11.2 Candidate Plant Sites

In the minutes of meeting exchanged at the time of conclusion of the Implementing Agreement (I/A) for this project in the Philippines by the Preliminary Survey Team and NIST, the following six regions were proposed as candidate plant sites:

Mindanao region	2 sites
Northern Luzon region	1 site
Bicol region	1 site
Southern Luzon region	1 site
Visayas region	1 site

However, since this proposal did not point out the specified places, the study team studied these candidate regions with emphasis placed on their raw material situation, based on which the team selected the following seven sites and conducted preliminary surveys of these sites during the 1st stage field survey from February 6th to March 6th, 1984:

(a) Cagayan de Oro and Butuan region (northern Mindanao).
(b) Davao region (southern Mindanao).

(c) Negros Island.
(d) Isabela Province (northern Luzon).
(e) Metro Manila region.
(f) Camarines Norte Province (southern Luzon).
(g) Laguna Province (central Luzon).

The findings of these surveys were described in detail in Chapter 7, so here only the results are shown in Table 11-1.

11.3 Selection of Plant Site

Differing from ordinary industrial plants, the powdered activated carbon manufacturing plant is comparatively small in scale and requires no massive mechanical facilities. However, since raw material sawdust as well as the product are bulky, a considerably wide space will be necessary for their storage.

Even in connection with utilities, no specially large facilities will be necessary since the water consumption rate is about 20 m^3/T and the power consumption rate about 500 kWh/T. Accordingly, the availability of stable supplies of raw material sawdust will be the primary criterion for selecting an optimum plant site.

The subject of availability of raw material sawdust was described in detail in Chapter 7. As the result, the study team concluded that the Davao region would be optimum as the plant site for this project in view of the raw material situation described in Chapter 7, section 7.4.2, other information acquired during the first field survey, and for the following reasons:

a) In the Davao region, numerous active sawmills are concentrated in a relatively limited area.

b) As compared with other candidate sites, sawmills in the Davao region are operating at higher rates and can be expected to provide stable supplies of sawdust.

c) Since the European or Japanese system of sawing is being adopted in this region and oil is used for cooling the bandsaws, the moisture content of the generated sawdust is 30–40% and almost the same as that of raw timber, enabling the sawdust to be used as the raw material for producing powdered activated carbon without having to pass it through the drying process.

Table 11-1. COMPARISON OF PLANT SITES

	Cagayan de Oro · Butuan	Davao	Negros	Isabela	Metro Manila	Camarines Norte	Laguna	Remarks
Lumber Production Capacity BDF/D	262,000 1) 652,000 2)	251,000 3) 558,000 4)	410,000	550,000	850,000	190,000	2.5 t/d *	* Coir Fiber Production Capacity
Lumber Production in 1982 m^3	21,134 1) 117,688 2)	43,664 3) 104,876 4)	67,475	181,051	97,826	941		
Number of Saw Mills	11 1) 24 2)	12 3) 28 4)	16	33	34	9	2	
Quantity of Saw Dust	Fair	Excellent	Poor	Fair	Good	Poor	Poor	
Collection of Saw Dust	Fair	Excellent	Poor	Good	Fair	Poor	Poor	
Characteristics of Saw Dust	Dry	Dry		Wet	Wet	Wet	Wet	
Price of Saw Dust	Free	Free		Free	Free	Free	Free	
Distance from Local Market	Far	Far	Far	Far	Near	Far	Near	
Transportation of Product	Good Port	Good Port	Port	By Land	By Land Good Port	By Land		

Notes: 1) Cagayan de Oro Area
2) Butuan Area
3) Davao del Norte Province
4) Davao del Sur Province

d) Since the Port of Davao is fully equipped with facilities for exporting timber and other commodities, the Davao region enables rational product shipment to domestic and foreign markets.

e) There is no problem even in connection with the procurement of necessary utilities.

11.4 Detailed Field Survey of Plant Site

Based on the observations described in the preceding section, the Davao region selected as an optimum plant site for this project was surveyed in greater detail through the Second Field Survey conducted during the period of from September 4th to the 28th, 1984.

11.4.1 Topography

The Davao region is situated in the southern part of Mindanao Island, at whose central part lies Davao City, the second largest city in the Philippines.

The northeastern to southwestern part of Davao City comprises a coastal region, and the northwestern part is a hilly region. The entire region of Davao City is inclined leniently, and excepting for housing areas, the land almost entirely consists of coconut forests.

11.4.2 Foundation

Many sawmills are concentrated in the northeastern and southwestern parts of Davao City and procurement of stable supplies of sawdust is expected there. Therefore, the study team made a detailed field survey these parts of Davao City.

The northeastern part of the city consists of a lenient stretch of hills rising from the coastline. The foundation, consisting of sandy layer and limestone for a few meters under the surface, is very firm. Meanwhile, the southwestern part of the city consists largely of flat terrain extending toward the coastline. Comprised largely of marshy land, this part of the city has a flimsy foundation, and traces of land subsidence were observed.

11.4.3 Climate

The weather in the Davao region is as shown in Table 11-2, based on local statistics for 1947–1975.

Table 11-2. CLIMATIOLOGICAL NORMALS (1974–1975)

Davao 755; Elevation 0018 m; Latitude 07 05 N; Longitude 125 37 E

Month	Rainfall (mm)	Rainy Days	Temperature (deg. °C)					Relative Humidity (%)	Sealevel Pressure (MBS)	Average		Cloudiness (0–8)
			Max. Temp.	Min. Temp.	Mean Temp.	Dry Bulb	Wet Bulb			Wind Direction (16 PTS)	Speed (MPS)	
Jan.	109.0	17	30.7	21.9	26.2	25.8	23.3	81	1,010.7	N	3	7
Feb.	100.1	16	30.9	22.0	26.4	25.9	22.3	73	1,011.0	N	3	7
Mar.	88.5	14	32.1	22.3	27.2	26.7	22.8	72	1,010.7	N	3	6
Apr.	147.3	16	32.8	22.9	27.8	27.4	24.4	78	1,009.9	N	2	6
May	227.6	22	31.5	20.2	25.8	26.8	24.8	85	1,009.6	N	2	7
Jun.	172.8	22	31.5	22.9	27.2	26.7	24.5	83	1,009.9	N	2	7
Jul.	181.7	20	31.3	22.5	26.9	26.7	24.3	82	1,009.8	N	2	7
Aug.	173.4	18	31.4	22.6	27.0	26.9	24.3	81	1,009.8	S	2	7
Sep.	189.9	19	31.7	22.6	27.1	26.9	24.4	81	1,009.8	N	2	7
Oct.	170.8	19	31.9	22.7	27.2	27.0	24.4	81	1,009.9	N	2	7
Nov.	153.5	18	31.9	22.5	27.2	26.8	24.3	81	1,009.8	N	2	7
Dec.	108.4	18	31.2	22.2	26.7	26.3	23.0	75	1,011.0	N	2	7
Annual	1,823.0	219	31.5	22.2	26.9	26.6	23.8	79	1,010.1	N	2	6

Note for Cloudiness 0 : Clear days 1–4 : Partly cloudy days 5–7 : Cloudy days 8 : Overcast

Published by Climate Division / C26

a) Rainfall

The annual rainfall runs up to 1,823 mm and precipitation increases in the period of from April to November. With little difference in number of rainy days in each month through a year, there is no clear demarkation between the dry and wet seasons.

b) Temperature

The temperature in the Davao region is generally stabilized throughout the year, with the maximum temperature rising to about 31.5°C and the minimum temperature falling to about 22.2°C to give a mean temperature of 26.9°C.

c) Humidity

With hardly any large variation throughout the year, the maximum humidity is 85%, the minimum humidity 75% and the mean humidity 79%. Therefore, the humidity is comparatively high throughout the year.

d) Wind Direction

Wind blows mostly northerly throughout the year and generally blow the mountainous side of Davao toward the coastline.

e) Earthquake

According to the Catalogue of Significant Philippine Earthquakes during the period of 1949–1980 supplied by the National Geophysical & Astronomical Office (NGAO) of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the number and intensities of earthquakes which occurred in the Davao region during the 32-year period were as follows:

Earthquake Intensities	Number of Times
I	6
II	27
III	18
IV	19

V	9
VI	0
VII	0
VIII	0
IX	0

Note: The ranking of earthquake intensities is in conformance with Table 11-3.

As shown above, the maximum earthquake intensity in the Davao region has been V so far, which is of medium intensity, so no major obstacle is likely when constructing the plant's building.

11.4.5 Utilities

a) Water

Water service pipes laid by the Davao City Water District are found in the entire municipal and suburban regions of Davao City marked off inside the slanting line shown in Fig. 11-1. Outside these regions, water is being obtained by digging deep wells which may be deeper than 100 feet.

Water quality data of city water and deep well water, supplied by the Davao City Water District and a sawmill, are shown below for reference.

	Deep Well	City Water
Alkalinity, ppm as $CaCO_3$	198	150
Total Hardness, ppm as $CaCO_3$	98	104
Cl^-, ppm	–	12
Total Iron, ppm	–	nil
pH	7	7.7

b) Electricity

Power distribution networks extend over Davao City's entire municipal and surrounding areas, so the plant for this project can be constructed without any major

Table 11-3. ROSSI-FOREL SCALE OF EARTHQUAKE INTENSITIES

(Adapted)

I. Hardly Perceptible Shock
Felt only by an experienced observer under favorable conditions.

II. Extremely Feeble Shock
Felt by a small number of persons at rest.

III. Very Feeble Shock
Felt by several persons at rest. Duration and direction may be perceptible. Sometimes dizziness or nausea experienced.

IV. Feeble Shock
Felt generally indoors, outdoors by a few. Hanging objects swing slightly. Creaking of frames of houses.

V. Shock of Moderate Intensity
Felt generally by everyone. Hanging objects swing freely. Overturn of all tall vases and unstable objects. Light sleepers awaken.

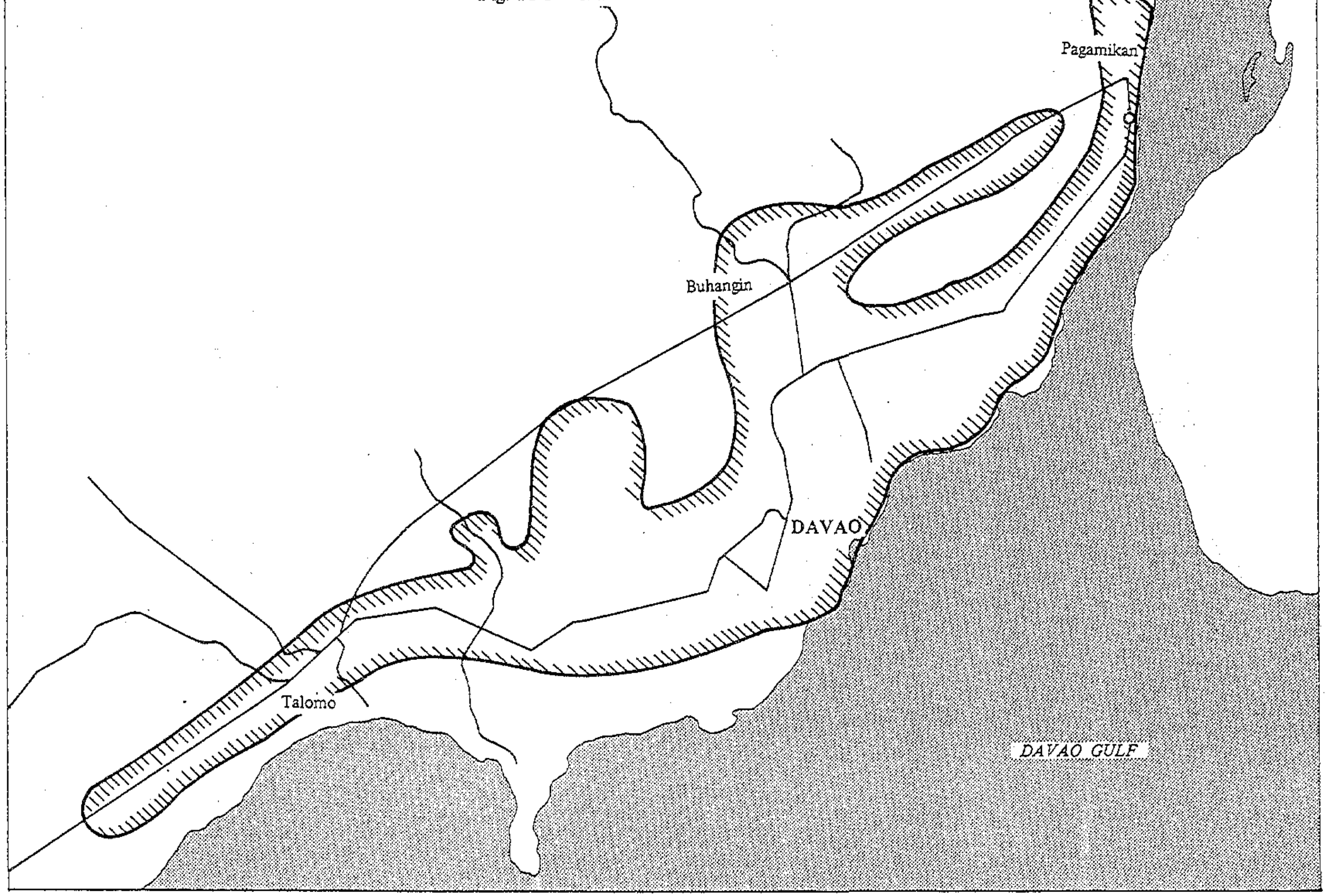
VI. Fairly Strong Shock
General awakening of those asleep. Some frightened persons leave their houses. Stopping of pendulum clocks. Oscillation of hanging lamps. Slight damage in very old or poorly built structures.

VII. Strong Shock
Overturn of movable objects. General alarm, all run outdoors. Damage slight in well-built houses, considerable in old or poorly-built structures, old walls, etc. Some landslides from hills and steep banks. Cracks in road surfaces.

VIII. Very Strong Shock
People panicky. Trees shaken strongly. Changes in the flow of springs and wells. Sand and mud ejected from fissures in soft ground. Small landslides.

IX. Extremely Strong Shock
Panic general. Partial or total destruction of some buildings. Fissures in ground. Landslides and rock falls.

Fig. 11-1 CITY WATER DISTRIBUTED AREA



obstacle.

There are three high-tension networks having line voltages of 69 kV, 13.8 kV and 8 kV, and three low-tension networks having line voltages of 440 V, 220 V and 110 V, among which the 13.8 kV line is the primary line of the high-tension networks and the 440 V line the primary line for general purposes. The 13.8 kV and 440 V lines are to be used in this project, and the electricity charge is about ₱0.7/kWh. (Refer to Appendix 10A-1.)

11.4.6 Pollution Regulations

The manufacture of powdered activated carbon essentially involves the process of carbonization of sawdust to produce char and the process of activation of the produced char. Accordingly, in view of the exhaust smoke generated by these processes, the plant will be subject to the folowing atmospheric pollution controls:

a) Particulate matter

300 mg/scm (standard cubic meter)

b) Carbon monoxide

500 mg/scm

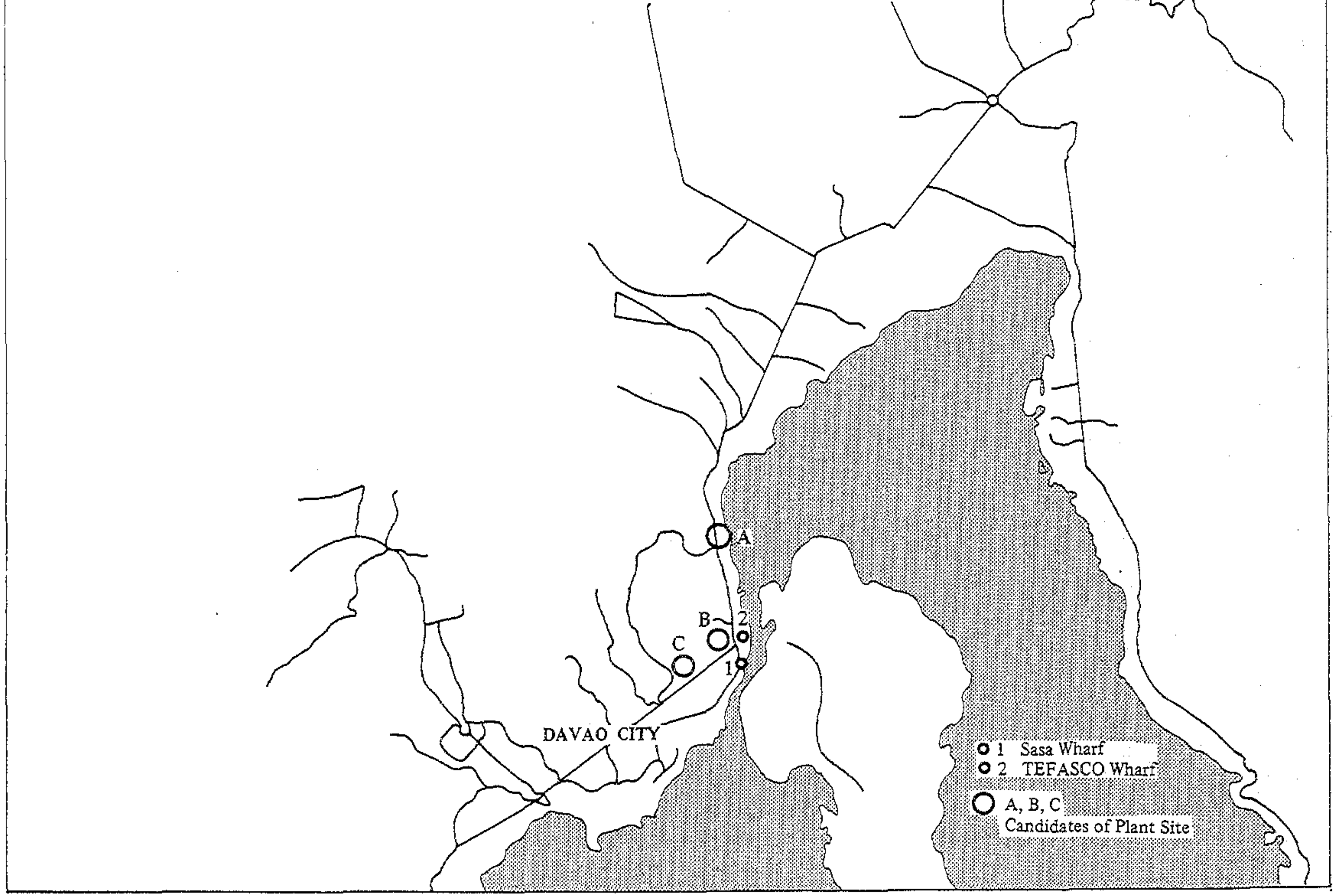
These control stipulations can be coped with satisfactorily since adequate dust and gas control equipment are installed.

Incidentally, should a need arise to expand the plant in the future with a process of refining of activated carbon, there is a possibility of effluent regulation being imposed by the authorities concerned, depending on the specific plant site.

11.4.7 Candidate Plant Sites

Based on the results of survey described above, the study team selected sites A, B and C lying in the northeastern part of Davao City, as shown in Fig. 11-2, as the best candidate plant sites for constructing the plant for manufacturing powdered activated carbon.

Fig. 11-2 CANDIDATES OF PLANT SITE



These three candidate sites are situated about 10 km away from sawmills delivering sawdust for the plant, and since they lie relatively close to Sasa Wharf and TEFASCO Wharf, they are highly convenient for both procurement of raw material sawdust and shipment of product.

The price of flat land in the area of A, B and C is approximately 100 ₱/m^2.

Chapter 12

PLANT CONSTRUCTION

Chapter 12. PLANT CONSTRUCTION

12.1 Plant Area and Building Area

The powdered activated carbon manufacturing plant is to be constructed in Davao City.

Since sawdust can be collected from sawmills operating in Davao City by transportation over short distances, there is no need to construct a carbonization plant separately, so the plan is to construct the carbonization plant and activation plant in the same plant site.

This plant is to be constructed at a site near a main highway, and the total plant area is roughly 10,000 m^2.

The building areas of principal plant buildings are as shown in Table 12-1.

Table 12-1 BUILDING AREA

Item	Building Area, m^2
Carbonization Plant	1,770
Activation Plant	768
Office, Laboratory	128
Gate House	10
Sawdust Stock Yard	200

Fig. 12-1 shows the general layout of the plant.

12.2 Civil Engineering Works

Civil engineering works for plant construction involve the preparation of plant construction site, construction of roads in the plant site, laying of water drainage channels, construction of outer water drainage ditches and the construction of plant fences and gates.

12.2.1 Preparation of Plant Construction Site

In the preceding Paragraph 11.4.7 on plant candidate sites, the three sites of A, B and C were recommended for selection as the optimum plant construction site, and with all of these recommended sites, no problem is encountered in the preparation of the plant construction site.

Plant construction area:	Roughly 10,000 m^2 (70 m x 140 m)
Ground level finishing height:	About 30 cm higher than the existing road surface level to prevent inundation in the rainy season.

When preparing the plant construction site, land clearing and grubbing are to be followed with ground leveling, in which case the places of insufficient soil are to be filled with soil hauling from the places where outer water drainage ditches, building foundation and near borrow pit.

Soil filled parts are to be finished by compaction by using a rubber-tire roller weighing more than 10 tons.

12.2.2 Roads in Plant Site

As shown in the "General Layout" of Fig. 12-1, the roads in the plant site are to be paved.

Road-paving area: 1,340 m^2

Specifications of paved roads:

Base course:	Finished thickness 20 cm, material used: crushed stone (or unscreened gravel), maximum grain size of aggregate: less than 80 mm.
Compaction:	With rubber-tired roller or three-wheel steel roller weighing over 10 tons (where these machines cannot be used, compaction is to be

	accomplished by using equipment such as small vibrating rollers).
Paving:	Finished to thickness of 5 cm by asphalt macadam method. Asphalt used: MC cutback asphalt. Compaction: Same method as for base course.

12.2.3 Water Drainage in Plant Site

Water drainage channels are to be constructed to drain water from the various buildings and paved roads in the plant site.

Total water drainage channels:	510 m
Construction and specifications:	U-shaped concrete drain blocks (or cast-in-place concrete) having sectional areas of 450 mm x 450 mm are to be laid.

12.2.4 Outer Water Drainage Ditch

Along the outer area of the plant site is to be provided an excavated drainage ditch without timbering, having an upper width of 3 m, bottom width of 1 m, depth of 1.5 m and sectional area of 3 m^2, in order to permit water drainage from the plant site and to prevent inflow of water into the plant site in case of floods. The total of the outer drainage system is 440 m.

12.2.5 Fence and Gates

Along the inner side of the outer water drainage ditch is to be erected a 4-stage fence having posts 1.8 m tall, distance between posts of 1.5 m and provided with barbed wires (#12). The total length is 380 m.

The gate is to be of double-door construction made of iron pipes, and having a height of 1.5 m and width of 7 m (3.5 m on one side). This gate is to be procured locally.

12.3 Building Construction Works

Building construction works include the construction of the Carbonization Plant, Activation Plant, Office and Laboratory Building, Gate House and Sawdust Stockyard. Design standards are based on the Japanese Architectural Society Standards (JASS), and the following design load conditions are adopted:

Maximum wind velocity:	40 m/sec.
Seismic factor:	0.1
Maximum rainfall:	50 mm/hr.

In order to meet process needs as well as structural needs, the housing proper (upper housing materials) of the Carbonization Plant and Activation Plant, excluding the foundation and concreting works, are to be prefabricated, imported and assembled at the site.

Other buildings are to be constructed by using materials procurable locally.

12.3.1 Carbonization Plant

Building area:	1,770 m^2. Housing proper: 1,680 m^2 (20 m x 84 m), after-burner room (30 m^2) at three places. (Refer to Figs. 12-2 and 12-3.)

The construction and specifications of the Carbonization Plant are as follows:

Structure:	Steel structure (SS-41).
Roof:	S.P. roofing EP (0.6 mm thickness roll-formed polyester-coated galvanized steel sheet with formed polyethylene 4 mm thickness).
Canopy:	S.P. roofing W (0.8 mm thickness roll-formed polyester-coated galvanized steel sheet).
Wall:	S.P. siding (0.5 mm thickness roll-formed polyester-coated galvanized steel sheet).

Gutter:	Eaves Gutter (hard vinyl-chloride, front height 200 mm). Down pipe (ϕ 90 mm, hard vinyl-chloride).
Foundation:	*Crushed stone (or unscreened gravel), thickness* 20 cm, area 1,875 m^2. Footing concrete: Foundation width 1 m, thickness 30 cm, concrete volume 63 m^3.
Floor concrete:	Thickness 15 cm, concrete volume 140 m^3.
Water supply facility:	1″ diameter pipe for open hearth furnace.
Electric wiring work:	Installation of lighting facilities consisting of 240 lamps (each 40 W, partly 60 w) for plant interior illumination at brightness of 120 lux.
Fittings:	For details, refer to Fig. 12-5.

12.3.2 Activation Plant

Building area:	768 m^2 (12 m x 64 m). Refer to Fig. 12-4.
Building construction and specifications:	Same as Carbonization Plant.
Foundation:	Crushed stone (or unscreened gravel). Construction and specifications same as Carbonization Plant, area 845 m^2. Footing concrete foundation: Construction and specifications same as Carbonization Plant. Concrete volume: 46 m^3.

Floor concrete: Construction and specifications same as Carbonization Plant.
Concrete volume: 140 m^3.

Water supply facility: Laying of ¾" pipes for service water in rest room. Toilet at two places.

Electric wiring work: Installation of lighting facilities consisting of 120 lamps (each 40 W, partly 60W) for plant interior illumination at brightness of 120 lux.

Fittings: Same as Carbonization Plant.
Refer to Fig. 12-5.

12.3.3 Office and Laboratory Building

Building area: 128 m^2 (8 m x 16 m).
Refer to Fig. 12-6.

The building is to be constructed by using locally available materials, and its construction and specification are as follows:

Foundation: Crushed stone or unscreened gravel.
Concrete footing foundation.

Structure: Light gauge section steel structure.

Roof: Corrugated slate.

Floor: Concrete floor.

Wall: Piled concrete blocks or bricks.

Interior finish: Hardboard or equivalent in quality.

Fittings: Aluminum sash frame, ordinary glass, plywood doors.

Electric wiring work: 10 lamps each for illuminating the office and laboratory, total 20 lamps (each 100 W).

1 lamp each for entrance and hall, total 2 lamps.
2 lamps for shower room (each 40 W).
Air conditioner, one set each for office and laboratory, together with wirings.
Others: Electric wiring for testing equipment in the laboratory.

Water supply facility: Piping of ¾" pipes in shower room and laboratory.

Sanitary plumbing facilities: 3 sets of shower systems and three sets of toilet facilities in shower room.

Ancillary facilities: Concrete septic tanks are to be installed at the positions shown in Fig. 12-1 and connected to sanitary facilities.

12.3.4 Gate House

Building area: $10\ m^2$ (2.5 m x 4 m).

The gate house is to be constructed by using locally procurable materials as in the case of the Office and Laboratory Building, and is designed with the same construction and specifications.

Electric wiring work: 2 lamps (each 40 W) are to be provided for room illumination.

Water supply facility: ¾" pipes are to be installed for the supply of service water and to supply water to one toilet room.

12.3.5 Sawdust Stockyard

A sawdust stockyard capable of storing (and drying during storage) about 4 days' equivalent of conveyed sawdust is to be constructed.

Materials:	Materials procurable locally.
Structure:	Wooden structure.
Roof:	Corrugated galvanized iron sheet having thickness of 0.5 mm.
Wall:	Inlined with boards for three sides, front side open.
Floor:	Concrete floor (10 cm thickness), finished with superelevation of 2%.

12.4 Ancillary Works

Ancillary works include the construction and installation of power receiving facility, plant site illumination facility, water supply facility (well), firefighting facility and telephone facility.

12.4.1 Power Receiving Facility

The principal power receiving facility is to consist of two sets of 100-kVA power transformers for working the pump, carbonization plant and activation plant, and one set of 75-kVA power transformer for illumination in general, also for working the air conditioner in the office room and laboratory, and for working laboratory equipment. A distributing panel is to be equipped in each plant. The materials necessary for the power receiving facility are to be imported except poles. (Refer to Fig. 12-1.)

12.4.2 Plant Illumination Facility

Outdoor lamps are to be provided at 20 places (one 100-W lamp at each place) for nighttime illumination of the plant site. (Materials procurable locally are to be used.)

12.4.3 Water Supply Facility (Well)

A well is to be dug in one corner of the plant site (refer to Fig. 12-1) for pumping water into a water tank (inner capacity 15 tons, height from ground 5 m). (Materials procurable locally are to be used.)

12.4.4 Firefighting Facility

Two-inch pipe from the water tank is connected to each building, where fire hydrants are to be installed at three places for safeguarding against fires. (Piping materials and fire hydrants are to be imported.) The total length of the 2″ pipes is about 320 m.

12.4.5 Telephone Facility

One telephone line is to be installed in the office.

12.5 Construction of Manufacturing Facilities

12.5.1 Open Hearth Carbonization Furnace

Open hearth carbonization furnaces are to be installed in two rows consisting of 28 units and 16 units, respectively, for a total of 44 units. Each furnace has a length of 5.4 m, width of 2.4 m and height of 0.6 m, and constructed primarily of ōya stone (tuff). The bottom of the furnace, made of concrete, is to be fabricated by using locally procured materials.

The flues which connect the open hearth furnaces to the after-burner room are to be made of local red brick and U-shaped concrete drain blocks.

12.5.2 After-Burner Room

Three sets of after-burner furnaces are to be installed. The combustion rooms of these imported after-burners (equipped with tank) are to be fabricated by piling up locally procured refractory bricks and red bricks. Imported adiabatic material is to be packed between refractory bricks and red bricks.

Meanwhile, the smokestack, having a length of 20 m and diameter of 40 cm, is to be fabricated with imported stainless steel plates. Other facilities primarily consist of imported machinery which are to be installed on concrete machine foundations prepared by using locally procured materials.

Fig. 12-7 shows the carbonization plant layout.

12.5.3 Activation Furnace

Altogether, three sets of activation furnaces are to be employed. These imported prefabricated activation furnaces are to be installed on concrete stands fabricated by using locally procured materials. The furnaces are to be covered with locally procured refractory bricks.

Other related facilities are to be imported and installed on concrete machine foundations prepared by using locally procured materials.

12.5.4 Crushing, Blending and Packing

Imported machinery for crushing, blending and packing of product are to be installed on concrete machine foundations prepared by using locally procured materials.

Fig. 12-8 shows the activation plant layout.

Incidentally, the work of installing the various principal facilities described above will have to be advanced under guidance of supervisors dispatched by the suppliers of these facilities.

12.6 Construction Schedule

Fig. 12-9 shows the construction schedule.

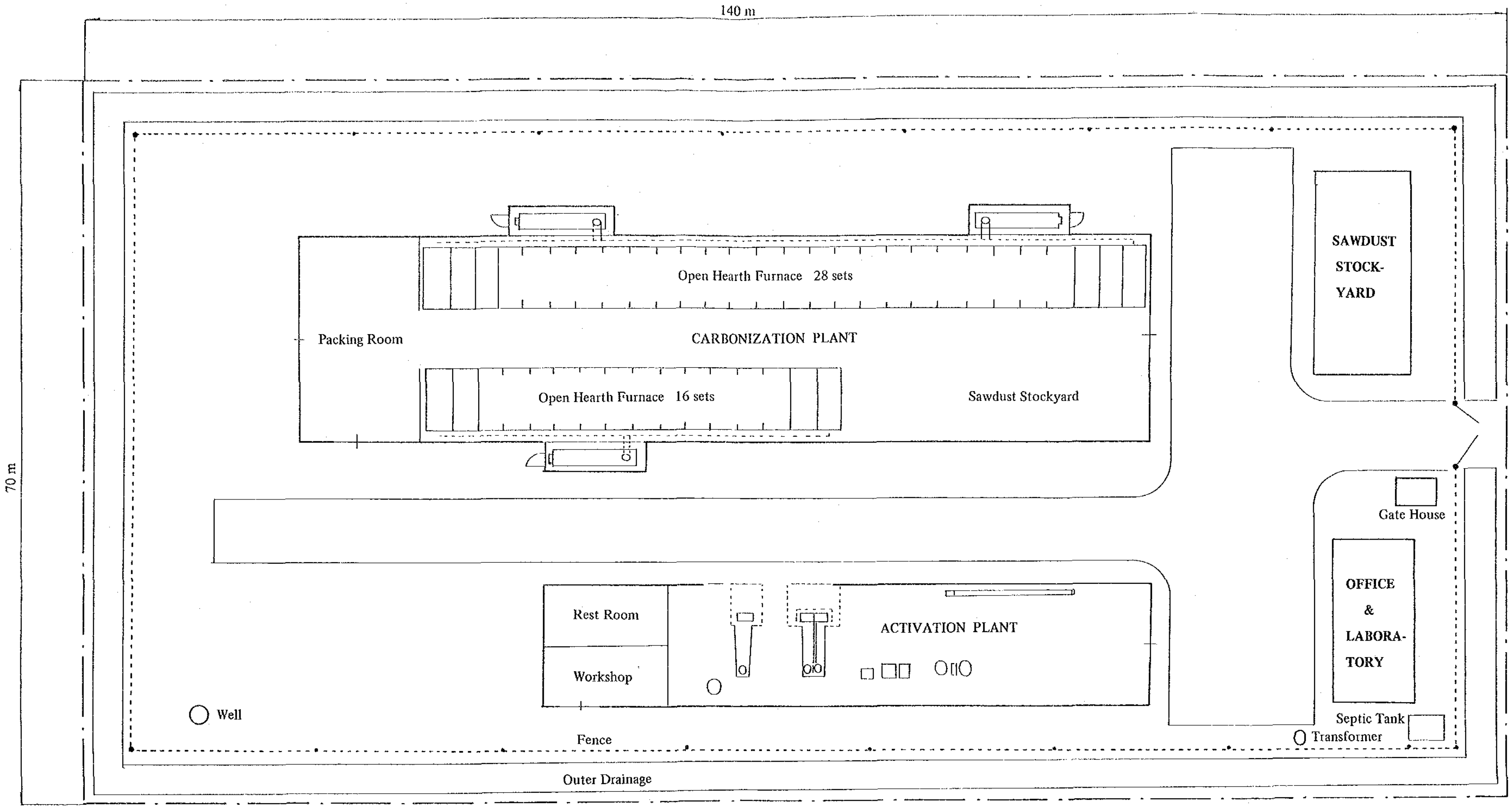
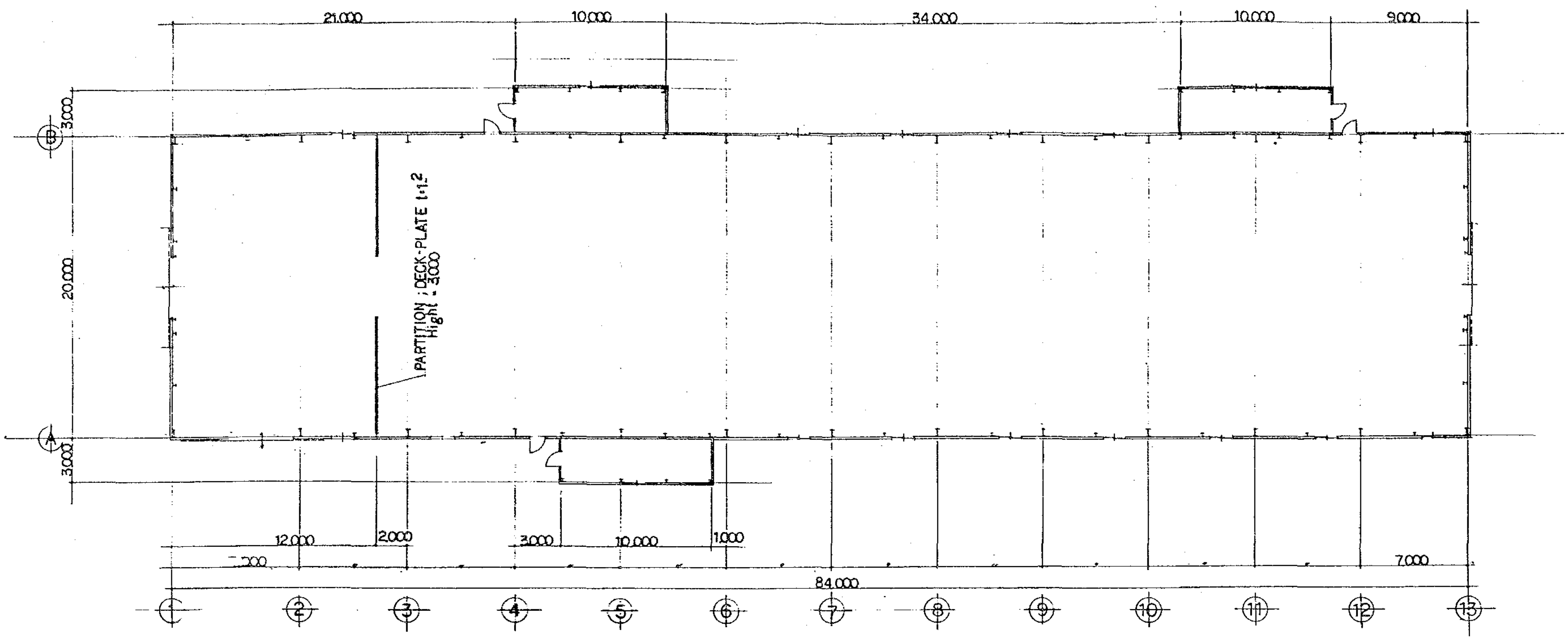


Fig. 12-1

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

POWDERED ACTIVATED CARBON PLANTS
GENERAL LAYOUT
Scale: 1 : 400



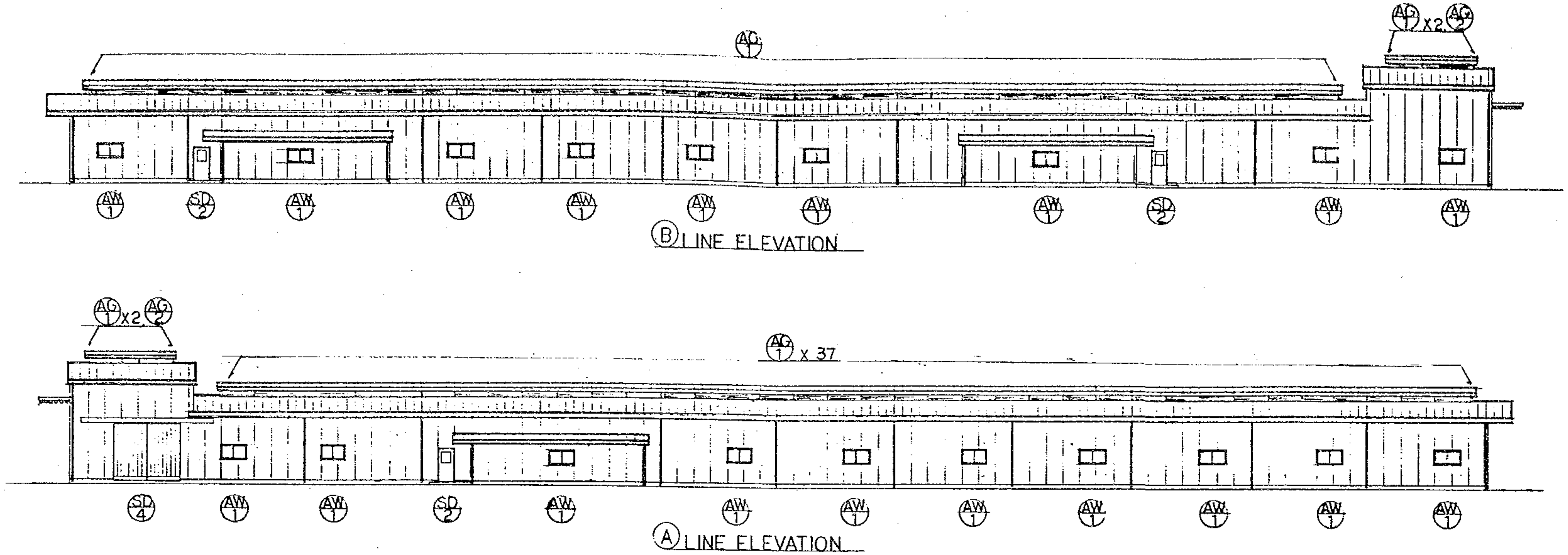
CARBONIZATION PLANT FLOOR PLAN

S = 1/200

Fig. 12-2

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

CARBONIZATION PLANT
FLOOR PLAN
Scale: 1:200



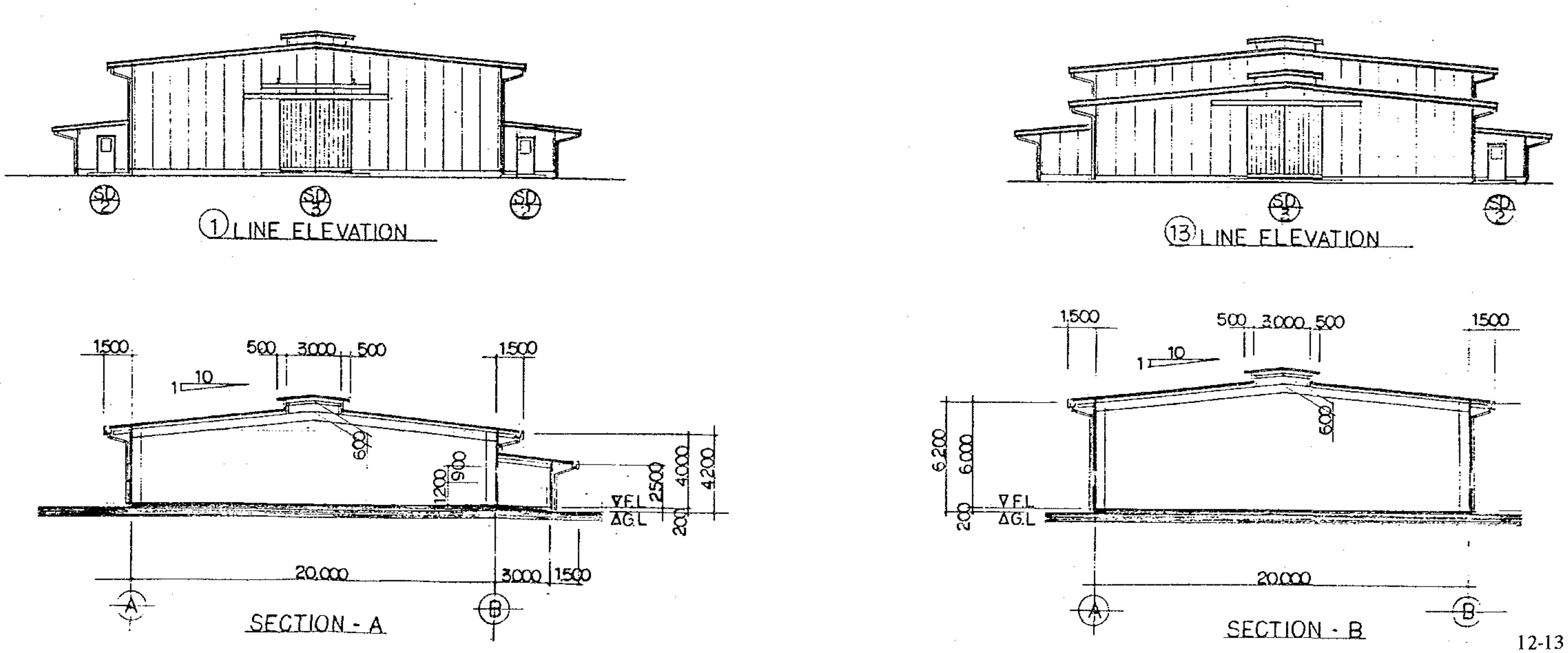


Fig. 12-3

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

CARBONIZATION PLANT
SECTION & ELEVATION
Scale: 1 : 200

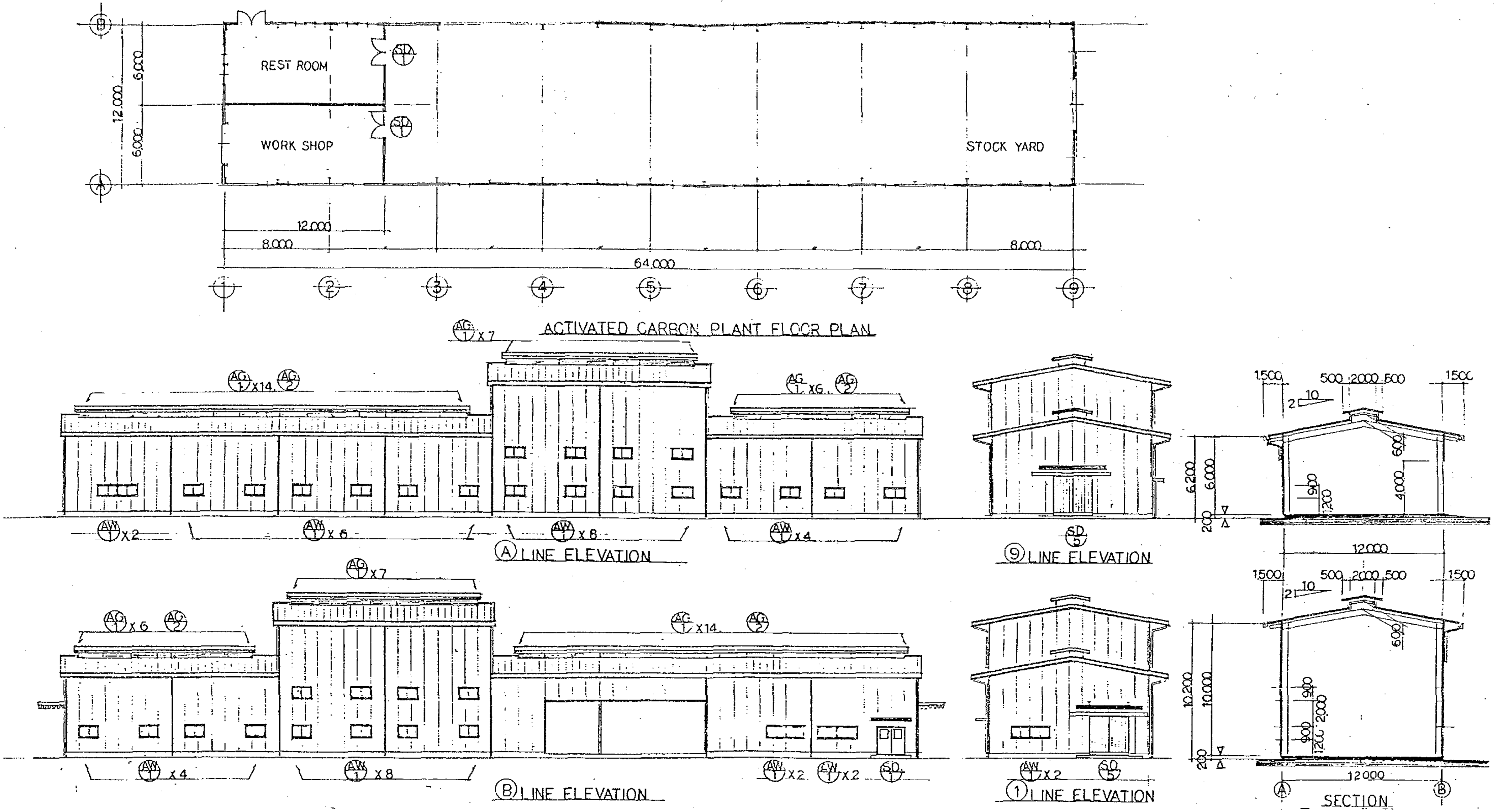


Fig. 12-4

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

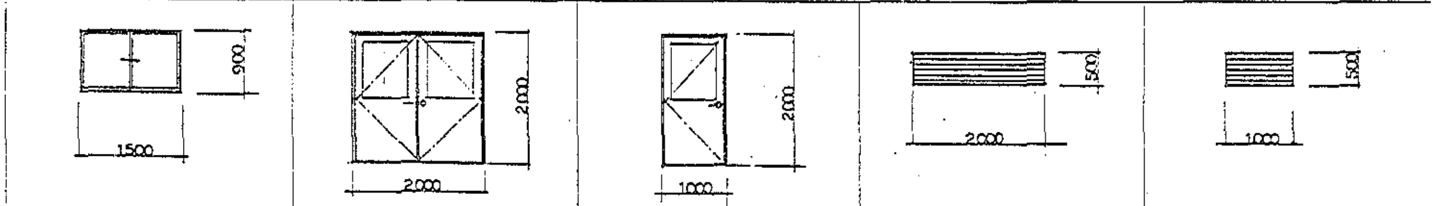
ACTIVATION PLANT
FLOOR PLAN, SECTION & ELEVATION
Scale: 1 : 200

EXTERNAL FINISH SCHEDULES

ROOF	S.P. ROOFING Ep (0.6mm THICK ROLL-FORMED POLYESTER-COATED GALVANIZED STEEL SHEET WITH FOAMED POLYETHYLENE 4mm THICK)
CANOPY	S.P. ROOFING W (0.6mm THICK ROLL-FORMED POLYESTER-COATED GALVANIZED STEEL SHEET)
WALL	S.P. SIDING (0.5mm THICK ROLL-FORMED POLYESTER-COATED GALVANIZED STEEL SHEET)
GUTTER	EAVES GUTTER (HARD VINYL CHLORIDE FRONT HEIGHT – 200 mm)
	DOWN PIPE (90 ϕ HARD VINYL CHLORIDE)

FITTINGS SCHEDULES

MARK	AW 1	SD 1	SD 2	AG 1	AG 2
NUMBER CARBONIZATION	19 NOS	—	6 NOS	78 NOS	2 NOS
NUMBER ACTIVATED CARBON	38 NOS	3 NOS	—	54 NOS	4 NOS
ELEVATION	(see drawings below)				
TYPE	ALUMINIUM DOUBLE SLIDING WINDOW	STEEL DOUBLE SWING DOOR	STEEL SINGLE SWING DOOR	ALUMINIUM LOUBER	ALMINIUM LOUBER
FINISH	ANODIC COATING	OIL PAINT FINISH	SAME AS LEFT	ANODIC COATING	SAME AS LEFT
GLASS	WIRED GLASS 6.8mm	WIRED GLASS 6.8mm	SAME AS LEFT	—	—
HARDWARE	CRESCENT	HINGE, KNOB CYLINDER LOCK, D.C	SAME AS LEFT	—	—
REMARK					



MARK	SD 3	SD 4	SD 5
NUMBER CARBONIZATION	2 NOS	1 NOS	—
NUMBER ACTIVATED CARBON	—	—	2 NOS
ELEVATION	(see drawings below)		
TYPE	STEEL SLIDING DOOR	STEEL SLIDING DOOR	STEEL SLIDING DOOR
FINISH	OIL PAINT FINISH	SAME AS LEFT	SAME AS LEFT
GLASS	—	—	—
HARDWARE	PAD LOCK, FLUSHBOLT	SAME AS LEFT	SAME AS LEFT
REMARK			

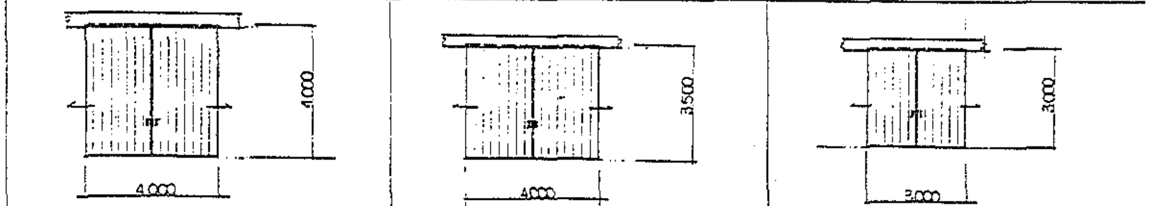
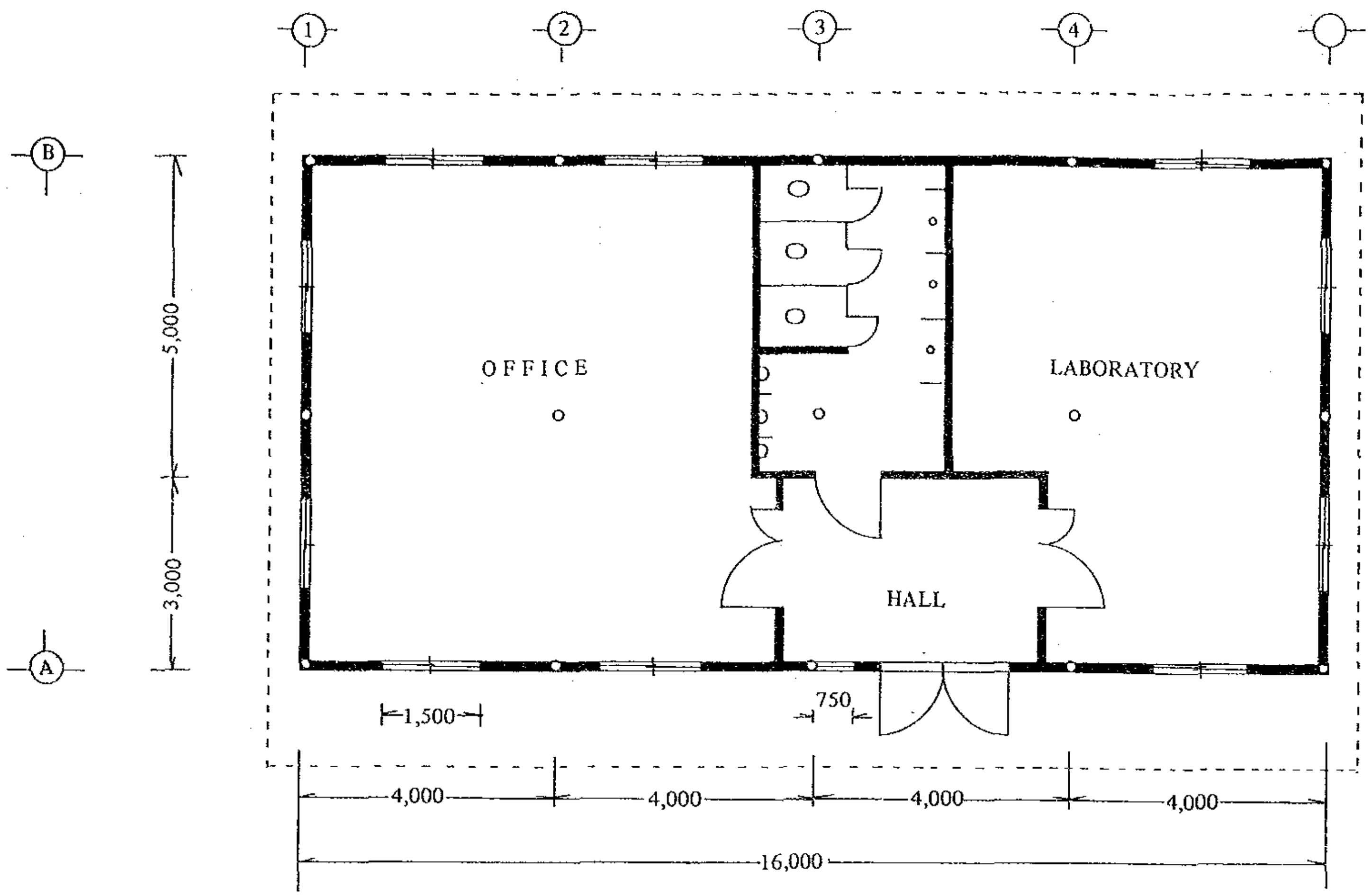


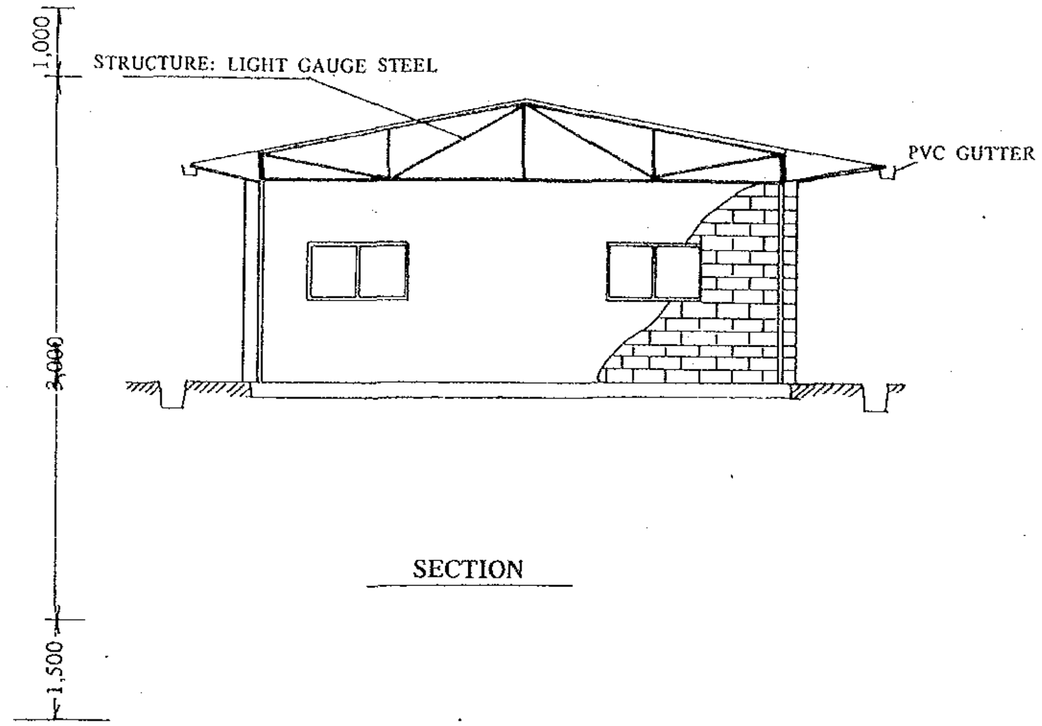
Fig. 12-5

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

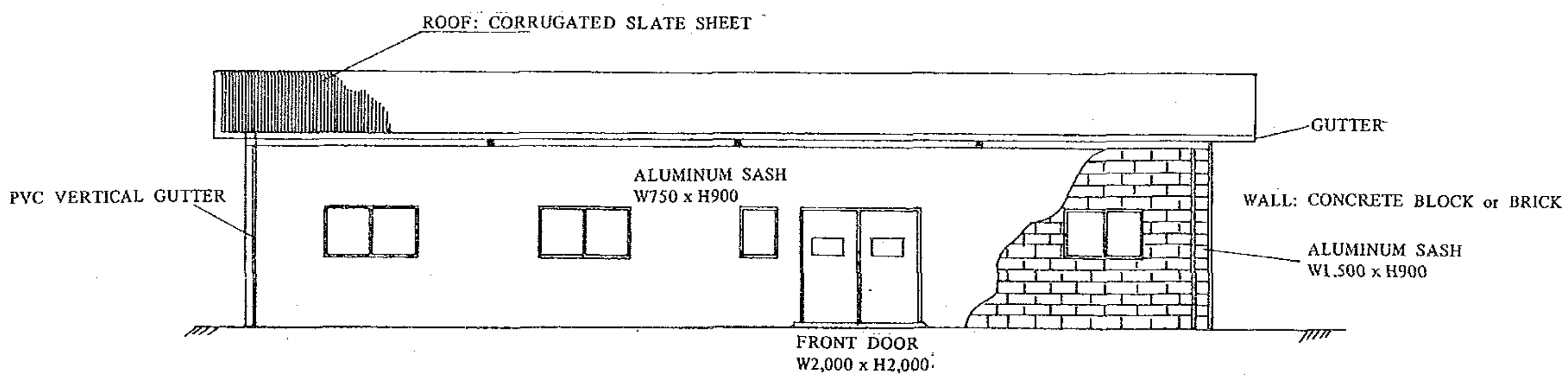
POWDERED ACTIVATED CARBON PLANTS
EXTERNAL FINISH SCHEDULES
FITTINGS SCHEDULES



FLOOR PLAN



SECTION



Ⓐ LINE ELEVATION

Fig. 12-6

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

POWDERED ACTIVATED CARBON PLANTS
OFFICE & LABORATORY
Scale: 1 : 100

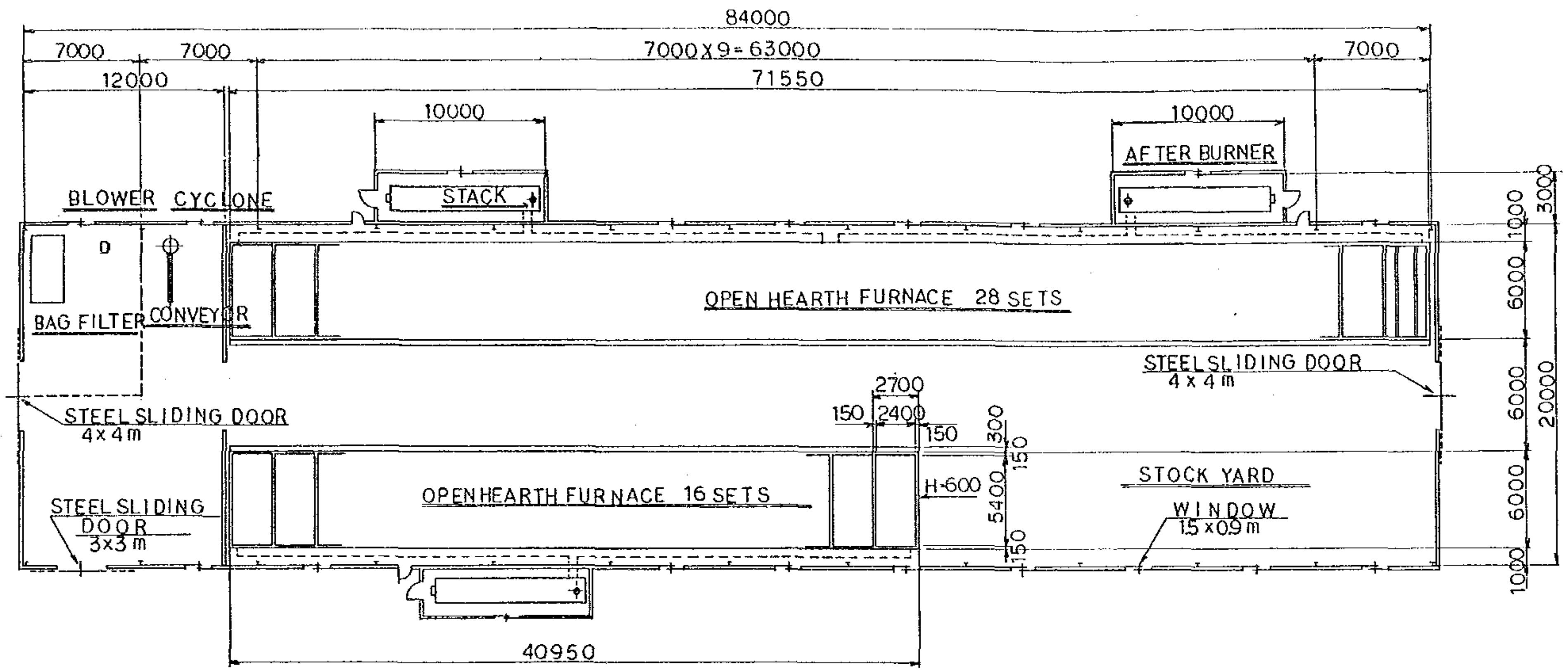


Fig. 12-7

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

CARBONIZATION PLANT
LAYOUT
Scale: 1 : 300

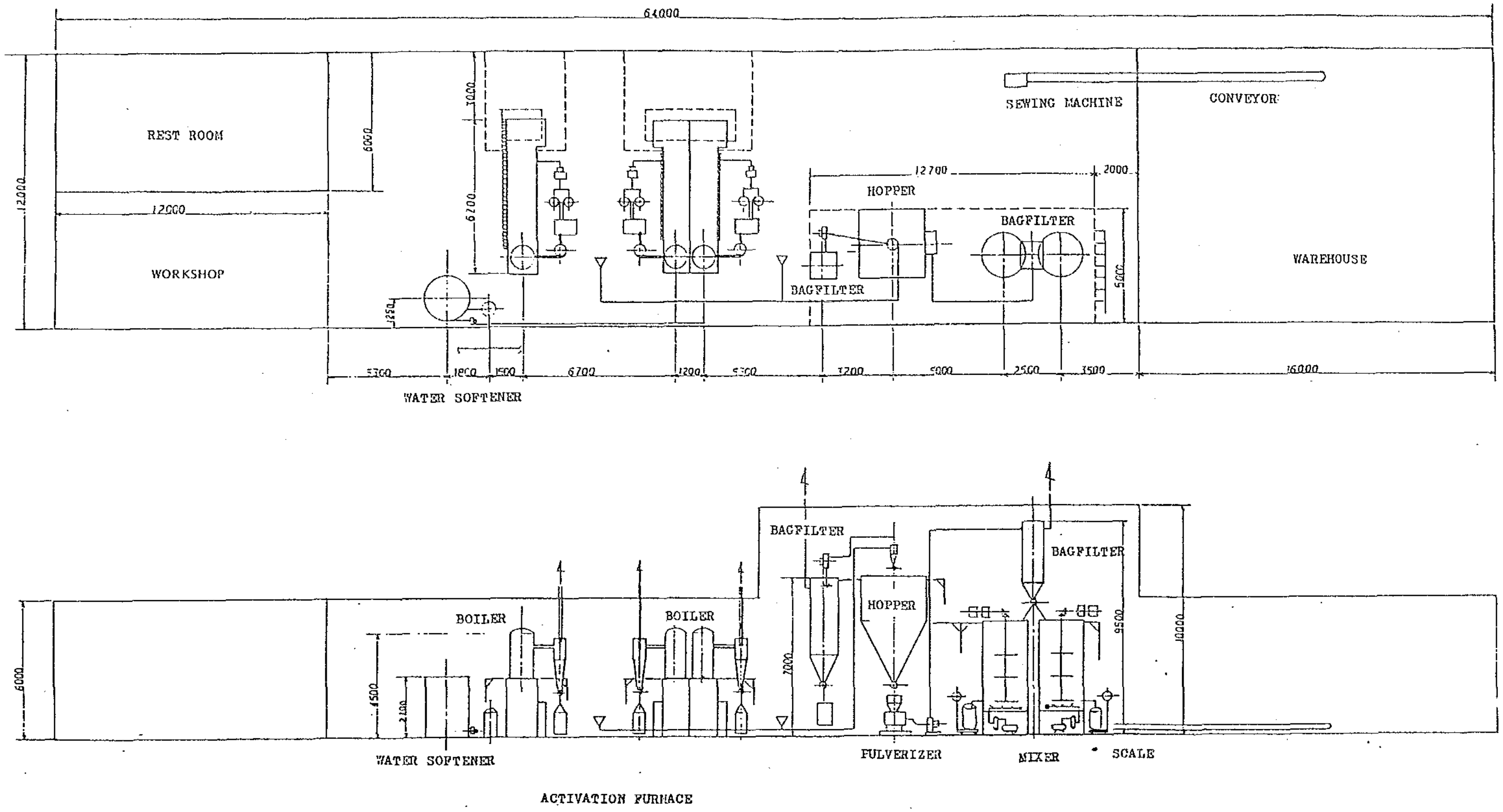
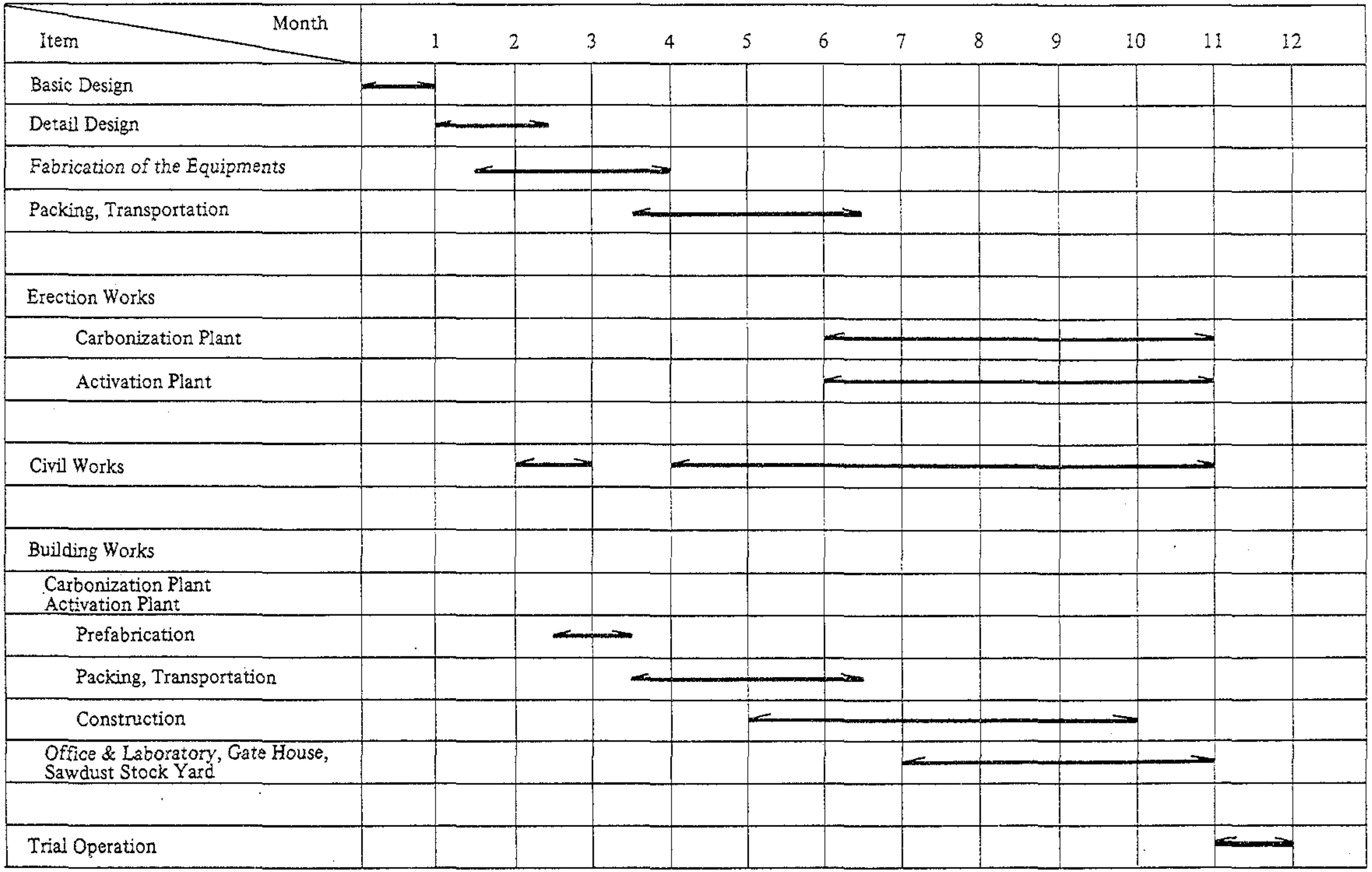


Fig. 12-8

THE FEASIBILITY STUDY ON
THE ESTABLISHMENT OF
THE POWDERED ACTIVATED CARBON PLANTS

ACTIVATION PLANT
LAYOUT
Scale: 1 : 200

Fig. 12-9 CONSTRUCTION SCHEDULE



Chapter 13

PLANT OPERATION

Chapter 13. PLANT OPERATION

13.1 Annual Number of Days of Plant Operation

As described earlier in Chapter 9, the powdered activated carbon manufacturing plant essentially consists of the carbonization plant and the activation plant. Center of these plants is their respective furnace which, incidentally, belong to different types.

Furnaces, whatever their types, should essentially be operated continuously from the aspects of both thermal efficiency and product quality control. In fact, with these carbonization and activation processes, long term and continuous operation of their furnaces with a 3-shift work system is necessary.

However, the activation furnaces and boilers will have to be shut-downed at least once a year for to remove clinker and scales, and for regular maintenance. Also, as observed from the aspect of raw material sawdust procurement, leading sawmills in the Davao region operate for about 300 days annually, and in order for the powdered activated carbon manufacturing plant to be operated at more than 300 days annually, it will be necessary to prepare a large-size warehouse for storing a massive volume of bulky sawdust, which will be highly disadvantageous.

In view of the above-mentioned need of shut-down period of the activation furnaces and boilers for maintenance work, and the annual operation days of sawmills, the plant for this project shall be operated for 300 days annually.

13.2 Plant Operation Rate

The technologies or processes for manufacturing of powdered activated carbon are essentially peculiar to the manufacturer concerned, so each manufacturer has special operation know-how to operate their plants.

It will be necessary for plant operators to receive technical guidance from the supervisors dispatched by plant supplier in connection with the operation and maintenance of plant, and quality control of products. Accordingly, the plant operation rate in initial year was assumed to be 70%.

From the second year and beyond, the plant shall be operated at a rate of 100%.

13.3 Training of Personnel

The manufacture of powdered activated carbon being an entirely new venture in the Philippines, ample training will have to be given to the main persons selected from the operators of the Davao Plant to be constructed under this project. Training shall be offered at in and out of the Philippines.

Training offered in the Philippines is hopeful for aquiring the analysis technology during the progress of this project at the NIST where provided well experienced analysts and testing instruments.

Meanwhile, overseas training shall be provided for acquiring technologies centering on activated carbon manufacturing process at the plant of activated carbon manufacturer coordinated by plant supplier or of plant supplier itself.

The terms of training will be estimated at 16-man-month.

For starting the plant operation, technical guidance on operation technologies in general will have to be received for a period of at least six months from the operational supervisors or instructors dispatched by the plant suppliers.

13.4 Description of Process

In Chapter 9, a description was given on the manufacturing processes from the aspects of machinery and equipment, so here a description is offered actual operation works on manufacturing processes.

13.4.1 Carbonization

1) Supply of Raw Material

Sawdust is conveyed from the sawdust stockyard in the plant site to the open hearth furnace and feeded into the central part of the furnace by means of the shovel cars, then feeded sawdust is made plain manually by workers.

2) Carbonization

Carbonization is completed in about four days, and new sawdust is supplied as needed according to the proceeding of carbonization.

3) Preparation of Discharge of Char from Furnace

When carbonization is almost terminated, uncarbonized sawdust which remains on the surface of the furnace is removed and transferred to subsequent furnace to completely carbonize this un-carbonized portion still lying at the top part of the char.

4) Discharge of Char from Furance

With termination of carbonization, carbonized sawdust is turned over well, then sprinkled with water to quench its fire. Next, the char is sucked up by means of suction device, passed through a cooler, weighed, then char is packed by 15 kg (bone dry) each in vinyl chloride bag and stored in the warehouse.

The furnaces, 44 units in all, each requires a sawdust char manufacturing time of 4 days, so char discharge work will be required for 11 furnaces per day.

13.4.2 Activation

1) Supply of Raw Material

Sawdust char packed in bags is conveyed from warehouse to a platform of activation furnace's hopper by means of forklift, where the sawdust char is fed into the hopper by hands.

2) Activation

Char fed from hopper into the activation furnace via a screw feeder is activated by reaction of steam in an environment of having a high temperature of 800–1,000°C. Activation will be completely terminated in a period of a few minutes at the longest.

3) Discharge from Furnace

After being activated, the activated carbon is discharged automatically from furnace into drum cans placed under the cyclone. After being weighed, the activated carbon is next transferred onto a pneumatic transfer hopper for further feed to the crusher's hopper.

13.4.3 Crushing, Mixing and Packing

1) Crushing

Activated carbon transferred to the crusher's hopper is fed into the crusher where it is crushed into fine particles, then sent to the mixing tank.

2) Mixing

The activated carbon is mixed uniformly in the fluidized mixing tank equipped with agitators.

3) Packing

Uniformly mixed activated carbon is weighed, then packed 20 kg each into bags. After the bags are left as packed for some time for settling of the activated carbon, the bags are sealed by sawing machines, then transferred to the product warehouse by means of a conveyor for storage.

13.5 Working Hours

Depending on the nature of works described above, the following works are to be carried out under 3-shift work system, while the others are done in a daytime work system.

(a) Works for feeding of raw material to the carbonization furnace and furnace operation.

(b) Works for operation of activation furnaces
These works are operated under 3-shift work system by three work teams.

13.6 Required Personnel

Fig. 13-1 shows the organization chart of plant.

Total required personnel for this plant based on the chart is 56 personnel as shown in Table 13-1. Among them, five persons are for management staff, and the other 51 persons are comprised of 35 skilled workers and 16 unskilled workers.

13.7 Required Personnel Expenses

Table 13-2 shows the cost of labor for the required personnel described above. The actual monthly payment figures shown in the table include various kinds of allowances.

Fig. 13-1 ORGANIZATION CHART

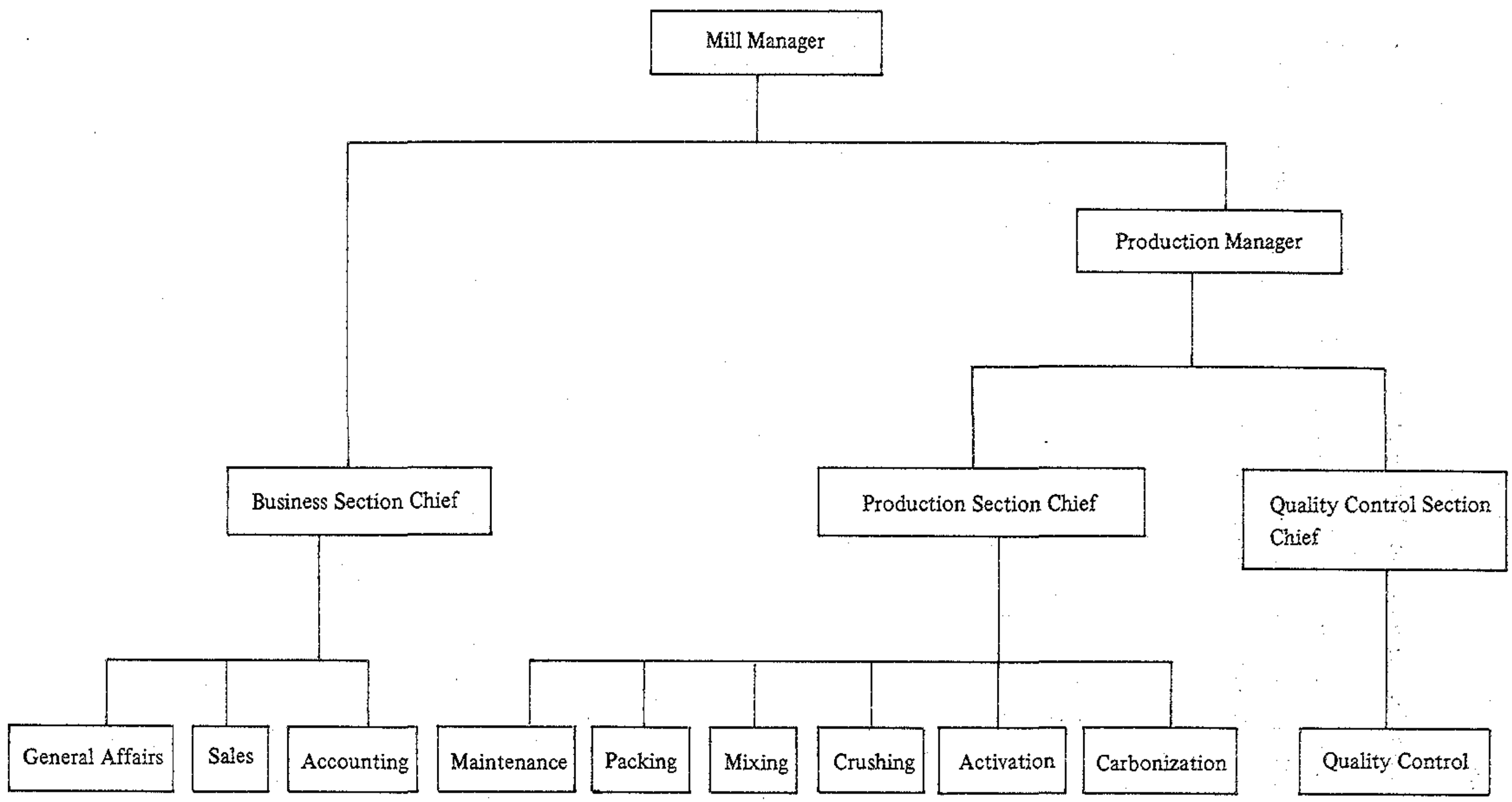


Table 13-1 PERSONNEL LIST

Process	Shift	Skilled Labor	Unskilled Labor	Total
Carbonization	3-shift	1 x 3	1 x 3	6
	Daytime	6	6	12
Activation	3-shift	2 x 3		6
Crushing	Daytime	1	1	2
Mixing	Daytime	2	2	4
Packing	Daytime	2	2	4
Maintenance	Daytime	2		2
Quality Control	Daytime	2		2
Accounting	Daytime	2		2
Sales	Daytime	1		1
General Affairs	Daytime	8	2	10
Total		35	16	51

Management Stuff

Mill Manager	1
Production Manager	1
Section Chief of Production Division	2
Business Section Chief	1
	5

Total Number of Personnel 56

Table 13-2 PERSONNEL EXPENSES (Sept., 1984)

Class	Kind of Wage	Number	Monthly Payment	Annual Payment
			₱	₱
Mill Manager	Salary	1	8,000	96,000
Production Manager	Salary	1	5,000	60,000
Section Chief	Salary	3	4,000	144,000
Sales Head	Salary	1	3,000	36,000
Clerk	Salary	3	2,000	72,000
Skilled Labor (3 shift)	Wage	9	1,800	194,400
Skilled Labor (daytime)	Wage	22	1,650	435,600
Unskilled Labor (3 shift)	Wage	3	1,500	54,000
Unskilled Labor (daytime)	Wage	13	1,400	218,000
Total		56		1,310,400 (US$72,800)*

* The personnel expenses will be estimated at US$82,242 in April, 1987.

Chapter 14

FINANCIAL REQUIREMENTS

Chapter 14. FINANCIAL REQUIREMENTS

14.1 Scope of Project

The following operations are included in this project:

(a) Procurement of land for the plant.
(b) Site preparation.
(c) Procurement of plant equipment.
(d) Installation of plant equipment.
(e) Construction of building.
(f) Installation of power receiving and distribution facilities.
(g) Acquisition of water.
(h) Erection of stack.
(i) Building of roads in plant compounds as well as access roads.
(j) Erection of fences.
(k) Procurement of raw material transportation trucks, fork lifts and shovel cars.
(l) Provision of fire hydrants.
(m) Installation of telephone exchange system.

14.2 Basis for Calculation of Expenses

The expenses for this project shall be calculated on the basis of the following conditions:

(a) The basic time for calculation shall be set at the end of September 1984, and the following exchange rates are adopted:

U.S.$1.00 = ₱18.00 = ¥245.00

(b) Plant equipment and main building materials shall be supplied from abroad on C.I.F. basis, and local erection and civil work as well as test run shall be carried out on the Philippine side under the guidance of supervisors dispatched from abroad.

(c) The expenses calculated on the above-mentioned conditions shall be added with the price rise occurring up to the time of completion of the plant.

(d) Contracts relating to supply of plant equipment, erection and civil works are assumed to be concluded in early April 1986 and completion of plant construction is assumed to be by the end of March 1987.

(e) Regarding calculation of the price rise mentioned above, the mean annual escalation rates are assumed to be as follows for the period of from the end of September 1984 to the end of March 1987:

Foreign currency portion (in U.S.$ equivalent)	5% annually*1
Local currency portion (in U.S.$ equivalent)	5% annually*2

*1 Refer to Appendix 14A-1
*2 Refer to Appendix 14A-2

(f) All expenses shall be indicated in U.S. dollar.

14.3 Incentives the Project Can Enjoy

In the case that the manufacture of wood-based powdered activated carbon is carried out in the Philippines, this will be the first enterprise. Therefore, by registering this project with the Board of Investments (BOI), it will be possible for the project to receive various incentives. In addition, since more than a half of the product is to be exported, it will also be possible for the project to receive another incentives as an export-oriented venture.

The kinds of incentives given in conformance with "Rules and Regulations to Implement (BATAS PAMBANSA BILANG 391)" will be as follows:

a) Exemption of import tax on imported equipment and spare parts.
b) Tax credit equivalent to 10% of net value earned.
c) Tax credit equivalent to 10% of net local content of exports.
d) Carry-over of losses to next account.

Note: Import tax will be exempted but an Ad Valorem Tax equivalent to 10% of the CIF prices of imported machinery will be imposed.

14.4 Financing Plan

The foreign currency portion of the required amount of funds is assumed to be procured through foreign loans under the following assumed conditions:

Term of repayment:	10 years (in equal installments)
Interest per annum:	8% and/or 12%

The other portion of the required amount of funds is financed by equity capital. However in case the operation fund becomes insufficient, the deficit portion shall be covered by a short term loan from a commercial bank with the annual interest rate of 30%.

14.5 Required Amount of Capital

The required amount of capital will consist of the following cost items:

14.5.1 Plant Cost

The plant cost will be as shown in Table 14-1. (See next page.)

14.5.2 Test Run Cost

A period of one month will be required for test run. The test run cost is calculated on the basis of the following assumptions:

During the one month of test run, raw material, utilities and supplies corresponding to 20 tons of product will be consumed.

The raw material cost will be as follows according to Table 10-1:

Sawdust	US$326
Electricity	US$380
Kerosene	US$1,396
Bag (for Storage)	US$80

Selling the product manufactured during the test run will be possible if its quality is good, and at least saleable as a non-standard product. However, in the calculation, its price

Table 14-1 TOTAL PLANT COST (As of Sept., 1984)

Upper Figures: Plant
Bottom Figures: Building & Civil Work

(US$)

	FC	LC	Total
Land		55,556	55,556
Machine & Equipment (FOB Japan)	414,871		414,871
Construction Material Imported (FOB Japan)	43,365 374,686		43,365 374,686
Engineering Fee	36,734		36,734
Freight & Insurance	36,498 49,832		36,498 49,832
Import Tax		49,474 42,452	49,474 42,452
Inland Transportation & Miscellaneous Expense		8,838 12,762	8,838 12,762
Construction Material, Local		24,730 68,679	24,730 68,679
Construction	53,000 22,000	6,288 30,923	59,288 52,923
Construction Equipment & Tools (Lease Charge)	6,000	24,197	30,197
Total	584,468 452,518	144,886 179,013	729,354 631,531
Grand Total	1,036,986	323,899	1,360,885

was evaluated as nil. Therefore, the expenses for packing bags are assumed to consist only of the expenses of transportation bags.

It will be necessary to operate the plant under the guidance of dispatched foreign supervisors during the period of test run, for which a cost of U.S.$6,000 is assumed, inclusive of airfare charges.

The total cost of local labor during the one-month period of test run, in accordance with Table 13-2, will run up to U.S.$6,067.

As for miscellaneous expenses, they are assumed to run up to 10% of the local expenses described above.

By adding all the costs described above, test run cost will be as shown in Table 14-2.

Table 14-2 TEST RUN COST (As of Sept., 1984)

(US$)

	FC	LC	Total
Raw material		326	
Electricity		380	
Kerosene		1,396	
Bag		80	
Supervision	6,000		
Labor		6,067	
Miscellaneous		825	
	6,000	9,074	15,074

14.5.3 Preoperation Cost

The preoperation cost is calculated on the basis of the following premise:

1) Expenses Related to Tender

It was pointed out in Chapters 8 and 9 that selecting the process used in the test would be the most ideal for this project. In this case, no special complicated procedures will be necessary for selecting machinery and equipment suppliers.

Also, regarding the selection of contractors for carrying out construction works, no difficult procedures will be necessary since the construction works are not complicated.

The expenses for the tender are assumed to be as follows:

a) Clerical expenses U.S.$3,000

b) Personnel expenses

Local personnel, 12 M-M U.S.$200/M-M

2) Expenses Related to Contract

a) Clerical expenses U.S.$2,000

b) Personnel expenses

Local personnel, 6 M-M U.S.$200/M-M

3) Expenses for Training of Plant Operators

Four workers selected from among those who will be employed at the Davao Plant receive specialized training overseas in connection with carbonization, activation, analysis and maintenance for a period of four months.

Overseas living expenses	U.S.$80/day x 30 x 4 x 4
Airfare charge	U.S.$1,000 x 4

4) Miscellaneous Expenses

Miscellaneous expenses are assumed to run up to 20% of the local expenses described above.

The total amount of the preoperation cost is shown in Table 14-3.

Table 14-3 PRE-OPERATION COST (As of Sept., 1984)

(US$)

	FC	LC	Total
Expenses for tender			
Clerical expenses		3,000	
Personal expenses		2,400	
Expenses for contract			
Clerical expenses		2,000	
Personal expenses		1,200	
Expenses for training	42,400		
Miscellaneous expenses		1,720	
	42,400	10,320	52,720

14.5.4 Initial Working Capital

As initial working capital, the amount equivalent to two months' sales amount was appropriated.

The ex-factory selling price of product is assumed at U.S.$1,300/T as of September 1984 prices, as pointed out in Chapters 6 and 8. Based on these premise, the initial working capital is assumed to be as shown in Table 14-4.

Table 14-4 INITIAL WORKING CAPITAL (As of Sept., 1984)

(US$)

	FC	LC	Total
Product		72,800	
Total		72,800	72,800

14.5.5 Investment Cost (As of September 1984)

By adding 10% of contingency to each of the expenses described above, the investment cost is calculated as shown in Table 14-5.

Table 14-5 INVESTMENT COST (As of Sept., 1984)

(US$)

	FC	LC	Total
Land		61,112	61,112
Machinery & Equipment	536,341	98,263	634,604
Building	497,770	196,914	694,684
Vehicle	106,574		106,574
Test Run Cost	6,600	9,981	16,581
Pre-operation Cost	46,640	11,352	57,992
Initial Working Capital		80,080	80,080
Total	1,193,925	457,702	1,651,627

14.5.6 Investment Required up to Completion of Plant Construction

The required amount of investment is calculated on the basis of costs as of the end of September 1984. However, the actual amount of funds necessary up to completion of the plant should be the required amount of funds disbursed at time of actual payment on the respective cost items. For this, it is necessary for the cost of each disbursement item shown in Table 14-5 to be escalated upto the time of each disbursement time.

As described before, the plant construction contracts for this project are to be concluded in April 1986 and the construction of the plant completed in March 1987. Based on this schedule, the time of disbursements of the cost items shown in Table 14-5 is assumed to be as shown in Table 14-6.

Table 14-6 DISBURSEMENT

	Time of Disbursement	Years after Sept., 1984
Plant Cost	Sept., 1986	2
Test Run Cost	Mar., 1987	2.5
Pre-operation Cost	Sept., 1986	2
Initial Working Capital	Mar., 1987	2.5

As pointed out in Paragraph 14.2, the annual escalation rate is assumed to be 5% in the years ahead. Therefore, the escalation rates up till the time of actual disbursement will be as follows:

	Escalation Rate
2 years	1.1025
2.5 years	1.1297

When the costs are escalated at these rates up till the time of their actual disbursement, the total amount of required investment cost will be as shown in Table 14-7.

Since the period of plant construction is one year, there will be no need to pay any interest during the period of construction.

Table 14-7 TOTAL INVESTMENT COST REQUIRED (By Apr., 1987)

(US$)

	FC	LC	Total
Land		67,376	67,376
Machinery & Equipment	591,316	108,335	699,651
Building	548,791	217,098	765,889
Vehicle	117,498		117,498
Test Run	7,456	11,276	18,732
Pre-operation Cost	51,420	12,516	63,936
Initial Working Capital		90,466	90,466
Total	1,316,481	507,067	1,823,548

14.5.7 Increase in Investment Cost Due to Delay in Project Implementation

The total required investment cost shown in Table 14-7 has been calculated on the assumption that the contract for plant construction will be concluded in April 1984. Therefore, if the schedule is delayed, the total required investment cost will be increased owing to price escalation. Table 14-8 shows what the total required investment cost will be with a delay of six months, one year and two years, respectively.

Table 14-8 INVESTMENT COST IN CASE OF DELAY IN IMPLEMENTATION

(US$)

Case	FC	LC	Total
6 Months Delay	1,348,991	519,589	1,868,580
1 Year Delay	1,382,305	532,420	1,914,725
2 Years Delay	1,451,420	559,041	2,010,461

Chapter 15

FINANCIAL ANALYSIS

Chapter 15. FINANCIAL ANALYSIS

15.1 Premises for Financial Analysis

The following conditions were adopted for making the financial analysis:

1) Plant Construction

Effectiveness of contract	April 1986
Completion of plant	March 1987

2) Plant Operation

Commencement of manufacture	April 1987
Plant operation rate	
Initial year	70%
Second and subsequent years	100%

3) Funds

Required investment funds

Domestic currency portion	US$507,067
Foreign currency portion	US$1,316,481
Total	US$1,823,548

Source of funds

Foreign currency portion: Long-term loans

Loan conditions:

a) Repayment period — 10 years (uniform repayment)

b) Interest 8% per annum (Case A)
12% per annum (Case B)

Domestic currency portion: Equity*

Interest during construction:

No interest will be incurred during plant construction since the construction period is one year.

(* Deficient short-term funds are assumed to be borrowed at an interest rate of 30% per annum.)

4) Cost of Raw Materials and Supplies*

Sawdust (including transportation fuel)	US$18.4/T-product
Electricity	US$21.5/T-product
Packing bags	
For char	US$4.5/T-product
For product	US$94.1/T-product
Kerosene	US$78.9/T-product

(* Refer to Table 15A-1-1.)

5) Labor Cost*

Annual labor cost US$82,242

(* Refer to Table 15A-1-2.)

6) Depreciation of Plant Facilities

Depreciation shall be by the straight line method over the following periods of years:

Machinery & equipment	10 years
Buildings	20 years
Vehicles	7 years
Others	10 years

Salvage Value is 10% of the original value of machinery and equipment, buildings and vehicles.

7) Maintenance Cost

The annual costs for the maintenance of plant facilities were estimated by multiplying the respective costs of plant facilities with the percentages shown below:

	1st Yr	2nd Yr	3rd Yr	4th Yr	5th Yr beyond
Machinery & equipment and vehicles	2%	2%	3%	4%	5%
Housings	2%	2%	2%	2%	2%

8) Insurance

The cost of insurance for plant facilities was assumed to run up to 1% of the costs for machinery and buildings.

9) Municipal and Other Expenses

Tax and related expenses were assumed to run up to 0.5% of the annual sales revenue.

10) Sales Expense

The sales expense was assumed to run up to 1% of the annual sales revenue.

11) Overhead

An annual overhead expense of US$60,000 as of Apr. 1987 was assumed, including the costs for corporate management personnel other than direct labor costs, clerical expenses for office and analysis work, transportation expenses and electricity charges not in cluded in direct manufacturing cost.

12) Operation Supervisory Expense

A supervisory expense of US$32,000 based on prices as of September 1984 (US$36,150 as of April 1987) was assumed for plant operation guidance by supervisors for a period of six months during the initial year of plant operation.

13) Corporate Income Tax

The corporate income tax rate is as follows:

0–₱100,000 (US$5,555.56)	25%
Over ₱100,000	35%

14) Tax Credits

The following two kinds of tax credits for fostering industries and promotion of exports are applied to this project for a period of five years from the time of commencement of plant operation:

(a) Tax credit on net value earned*1
(b) Tax credit on net local content of exports*2

The total amount of tax credits available through the application of these tax credit systems will exceed the amount of corporate income tax, so this will be equivalent to an income tax exemption for a period of five years from the time of commencement of plant operation.

(*1; Refer to Appendix 15A-1-2.)
(*2; Refer to Appendix 15A-1-3.)

15) Unit Selling Price of Product

The ex-factory price of the product, based on prices as of September 1984, is US$1,600/T for the domestic market and US$1,200/T for export markets. The mean price will be US$1,300/T, which will be US$1,470/T based on prices as of April 1987.

16) Project Life

The project life used in the financial analysis is 10 years.

15.2 Schedule for Repayment of Long-Term Loans

The schedule for the repayment of long-term loans is as shown in Table 15-1 (Case A) and Table 15-2 (Case B).

15.3 Financial Statements for Base Case

15.3.1 Production Cost Statements

The production costs are shown in Table 15-3 (Case A), Table 15-4 (Case B), Table 15-5 (Case A) and Table 15-6 (Case B).

According to these tables, variable cost accounts for only a small ratio of the product cost. Also, in both Case A and Case B, the unit product cost is less than the unit sales price of the product, excepting for the initial year of plant operation. However, in Case B, short-term loan will be necessary up to the second year of plant operation, so a heavy burden is incurred for the payment of interest.

15.3.2 Income Statement

The income statements are as shown in Table 15-7 (Case A) and Table 15-8 (Case B).

In Case A and Case B, profit is realized from the second year of plant opeation, and the ratio of profit after tax to sales revenues is very high.

As compared with the profit ratios in general of manufacturing industries in industrially advanced countries, the ratio of profit after tax to sales revenues in this project is very high, indicating the excellent profitability of this project.

15.3.3 Funds Flow Statement

Funds flow statements are as shown in Table 15-9 (Case A) and Table 15-10 (Case B).

Regarding the fund flow of this project, in Case A a temporary shortage of funds will be encountered in the initial year of plant operation, and in Case B up to the second year of plant oepration, making short-term loan necessary. Subsequently, however, it will be possible to repay both interest and principal on the borrowed fund through the project's own production and sales programs. Therefore, with this project, there is no special problem in the aspects of fund flow.

15.3.4 Balance Sheet

The balance sheets are as shown in Table 15-11 (Case A) and Table 15-12 (Case B).

A great amount of retained earnings will remain in the final year of project life. Also, since current assets far outstrip current liabilities, the financial siutation of this project can be regarded as being very sound.

15.3.5 Break-even Point Analysis

Graphs indicating the break-even points are shown in Fig. 15-1 (Case A) and Fig. 15-2 (Case B). The break-even point for the respective years during the ten-year period lies on the straight line existing between BEP1 and BEP2.

In Case A, reasonable break-even points are obtained throughout the entire period of plant operation, while in Case B the break-even points indicate reasonable values excepting for the initial stage of plant operation.

This project is characterized by a low ratio of variable costs with respect to the unit production cost, so profits can be earned even with a low plant operation rate during the period in which the interest burden is low.

15.3.6 Internal Rate of Return

1) The internal rates of return, as shown in Tables 15-13 to 15-16, are as follows:

Case A

ROI (before tax)	15.27%
ROI (after tax)	13.58%
ROE (after tax)	21.26%

Case B

ROI (before tax)	14.91%
ROI (after tax)	13.33%
ROE (after tax)	15.03%

2) Sensitivity Analysis

The internal rates of return, when the sales price, variable cost and investment cost fluctuate by +10% and -10%, are as shown in Fig. 15-3 (Case A) and Fig. 15-4 (Case B).

15.4 Observation and Evaluation

Based on the results of financial analysis described above, the following observation and evaluation were made of this project:

1) Based on the results of the financial analysis described above, the project is judged to be feasible from the financial aspect.

2) In this project, plant equipment and building materials are to be imported from Japan. Therefore, the project's investment cost will be influenced by fluctuations in the foreign currency exchange rate between the Japanese yen and the U.S. dollar. Accordingly, concluding the project contract while the exchange value of the Japanese yen is low with respect to the U.S. dollar will be highly advantageous for this project.

3) The basic policy of this project is to export three-fourths of the product manufactured through this project primarily to the Japanese market. Therefore, the selling price of the product is liable to be influenced from the following two aspects depending on fluctuations in the foreign currency exchange rate between the Japanese yen and the U.S. dollar:

(a) Competition with Products Imported into Japan from Neighboring Countries

A fluctuation in the foreign exchange rate between the yen and the U.S. dollar may have an influence on the sales price of the product manufactured through this project. However, the same influence will be exerted to other products which are being imported into Japan from neighboring countries. Therefore, a fluctuation in the foreign exchange rate will not exert any large influence on the selling price of this project's product.

(b) Competition with Japanese Domestic Products

A fluctuation in the foreign exchange rate between the yen and the U.S. dollar will influence the competition between this project's product and Japanese domestic product. However, in view of the trend for the costs of manufacturing powdered activated carbon to rise steadily in Japan in recent years, the fluctuation is not expected to exert any large influence on the export price of this project's product, excepting the case of excessive fluctuation in the foreign exchange rate.

Table 15-1 (Case A)

REPAYMENT SCHEDULE FOR LONG TERM LOAN & BOND

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
(FOREIGN CURRENCY)									
LONG TERM LOAN	0	1.316.481	0	0	0	0	0	0	0
PRINCIPAL REPAYMENT	0	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648
INTEREST REPAYMENT	0	0	105.319	94.787	84.255	73.723	63.191	52.659	42.127
DEBT (PRIN.+INTER.)	0	0	236.967	226.435	215.903	205.371	194.839	184.307	173.776
BALANCE AFT.PAYMENT	0	1.316.481	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944
FOREIGN REPAYMENT	0	0	236.967	226.435	215.903	205.371	194.839	184.307	173.776
(DOMESTIC CURRENCY)									
DOMESTIC REPAYMENT	0	0	0	0	0	0	0	0	0
TOTAL REPAYMENT	0	0	236.967	226.435	215.903	205.371	194.839	184.307	173.776

Table 15-1 (Case A) (Continued)

REPAYMENT SCHEDULE FOR LONG TERM LOAN & BOND

PHIL. P.:A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
(FOREIGN CURRENCY)			
LONG TERM LOAN	0	0	0
PRINCIPAL REPAYMENT	131.648	131.648	131.648
INTEREST REPAYMENT	31.596	21.064	10.532
DEBT (PRIN.+INTER.)	163.244	152,712	142.180
BALANCE AFT.PAYMENT	263.296	131.648	-0
FOREIGN REPAYMENT	163,244	152.712	142.180
(DOMESTIC CURRENCY)			
DOMESTIC REPAYMENT	0	0	0
TOTAL REPAYMENT	163.244	152.712	142.180

Table 15-2 (Case B)

REPAYMENT SCHEDULE FOR LONG TERM LOAN & BOND

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
(FOREIGN CURRENCY)									
LONG TERM LOAN	0	1.316.481	0	0	0	0	0	0	0
PRINCIPAL REPAYMENT	0	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648
INTEREST REPAYMENT	0	0	157.978	142.180	126.382	110.584	94.787	78.989	63.191
DEBT (PRIN.+INTER.)	0	0	289.626	273.828	258.030	242.233	226.435	210.637	194.839
BALANCE AFT.PAYMENT	0	1.316.481	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944
FOREIGN REPAYMENT	0	0	289.626	273.828	258.030	242.233	226.435	210.637	194.839
(DOMESTIC CURRENCY)									
DOMESTIC REPAYMENT	0	0	0	0	0	0	0	0	0
TOTAL REPAYMENT	0	0	289.626	273.828	258.030	242.233	226.435	210.637	194.839

Table 15-2 (Case B) (Continued)

REPAYMENT SCHEDULE FOR LONG TERM LOAN & BOND

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
(FOREIGN CURRENCY)			
LONG TERM LOAN	0	0	0
PRINCIPAL REPAYMENT	131.648	131.648	131.648
INTEREST REPAYMENT	47.393	31.596	15.798
DEBT (PRIN.+INTER.)	179.041	163.244	147.446
BALANCE AFT.PAYMENT	263.296	131.648	-0
FOREIGN REPAYMENT	179.041	163.244	147.446
(DOMESTIC CURRENCY)			
DOMESTIC REPAYMENT	0	0	0
TOTAL REPAYMENT	179.041	163.244	147.446

Table 15-3 (Case A)

PRODUCTION COST STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
PRODUCTIN VOLUME	0	0	336	480	480	480	480	480	480
SAWDUST	0	0	336	480	480	480	480	480	480
ELECTRICITY	0	0	336	480	480	480	480	480	480
BAG	0	0	336	480	480	480	480	480	480
KEROSENE	0	0	336	480	480	480	480	480	480
MATERIALS VOLUME	0	0	1.344	1.920	1.920	1.920	1.920	1.920	1.920
DETAILS OF MATERIAL									
SAWDUST	0	0	6.182	8.832	8.832	8.832	8.832	8.832	8.832
ELECTRICITY	0	0	7.224	10.320	10.320	10.320	10.320	10.320	10.320
BAG	0	0	33.130	47.328	47.328	47.328	47.328	47.328	47.328
KEROSENE	0	0	26.510	37.872	37.872	37.872	37.872	37.872	37.872
RAW MATERIALS COST	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
BY-PRODUCT CREDITS	0	0	0	0	0	0	0	0	0
VARIABLE COST TOTAL	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
MAINTENANCE	0	0	31.656	31.656	39.828	48.000	56.172	56.172	56.172
LABOR	0	0	82.242	82.242	82.242	82.242	82.242	82.242	82.242
INSURANCE	0	0	15.830	15.830	15.830	15.830	15.830	15.830	15.830
FIXED COST TOTAL	0	0	129.728	129.728	137.900	146.072	154.244	154.244	154.244
DEPRCI. & AMOTIZAT.	0	0	120.807	120.807	120.807	120.807	120.807	120.807	120.807
EX-FACTORY PRD.COST	0	0	323.582	354.887	363.059	371.231	379.403	379.403	379.403
UNIT DIRECT COST	0.00000	0.00000	963.04084	739.34859	756.37359	773.39859	790.42359	790.42359	790.42359
SUPERVISION	0	0	36.150	0	0	0	0	0	0
SALES EXPENSE	0	0	4.939	7.056	7.056	7.056	7.056	7.056	7.056
OVERHEAD	0	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000
MUNICIPAL TAX	0	0	2.058	3.352	3.528	3.528	3.528	3.528	3.528
INTR.ON L-TERM DEBT	0	0	105.319	94.787	84.255	73.723	63.191	52.659	42.127
INTR.ON S-TERM DEBT	0	0	0	21.870	0	0	0	0	0
PRODUCT COST	0	0	532.047	541.952	517.898	515.538	513.178	502.647	492.115
UNIT PRODCT COST	0.00000	0.00000	1583.47466	1129.06637	1078.95453	1074.03816	1069.12179	1047.18042	1025.23906

Table 15-3 (Case A) (Continued)

PRODUCTION COST STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
PRODUCTIN VOLUME	480	480	480
SAWDUST	480	480	480
ELECTRICITY	480	480	480
BAG	480	480	480
KEROSENE	480	480	480
MATERIALS VOLUME	1.920	1.920	1.920
DETAILS OF MATERIAL			
SAWDUST	8.832	8.832	8.832
ELECTRICITY	10.320	10.320	10.320
BAG	47.328	47.328	47.328
KEROSENE	37.872	37.872	37.872
RAW MATERIALS COST	104.352	104.352	104.352
BY-PRODUCT CREDITS	0	0	0
VARIABLE COST TOTAL	104.352	104,352	104.352
MAINTENANCE	56.172	56.172	56.172
LABOR	82.242	82.242	82.242
INSURANCE	15,830	15.830	15,830
FIXED COST TOTAL	154.244	154.244	154.244
DEPRCI. & AMOTIZAT.	105.700	105.700	105.700
EX-FACTORY PRD.COST	364.296	364.296	364.296
UNIT DIRECT COST	758.95091	758.95091	758.95091
SUPERVISION	0	0	0
SALES EXPENSE	7.056	7.056	7.056
OVERHEAD	60.000	60.000	60.000
MUNICIPAL TAX	3.528	3.528	3,528
INTR.ON L-TERM DEBT	31.596	21.064	10.532
INTR.ON S-TERM DEBT	0	0	0
PRODUCT COST	466.476	455.944	445.412
UNIT PRODCT COST	971.82501	949.88364	927.94227

Table 15-4 (Case B)

PRODUCTION COST STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
PRODUCTIN VOLUME	0	0	336	480	480	480	480	480	480
SAWDUST	0	0	336	480	480	480	480	480	480
ELECTRICITY	0	0	336	480	480	480	480	480	480
BAG	0	0	336	480	480	480	480	480	480
KEROSENE	0	0	336	480	480	480	480	480	480
MATERIALS VOLUME	0	0	1.344	1.920	1.920	1.920	1.920	1.920	1.920
DETAILS OF MATERIAL									
SAWDUST	0	0	6.182	8.832	8.832	8.832	8.832	8.832	8.832
ELECTRICITY	0	0	7.224	10.320	10.320	10.320	10.320	10.320	10.320
BAG	0	0	33.130	47.328	47.328	47.328	47.328	47.328	47.328
KEROSENE	0	0	26.510	37.872	37.872	37.872	37.872	37.872	37.872
RAW MATERIALS COST	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
BY-PRODUCT CREDITS	0	0	0	0	0	0	0	0	0
VARIABLE COST TOTAL	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
MAINTENANCE	0	0	31.656	31.656	39.828	48.000	56.172	56.172	56.172
LABOR	0	0	82.242	82.242	82.242	82.242	82.242	82.242	82.242
INSURANCE	0	0	15.830	15.830	15.830	15.830	15.830	15.830	15.830
FIXED COST TOTAL	0	0	129.728	129.728	137.900	146.072	154.244	154.244	154.244
DEPRCI. & AMOTIZAT.	0	0	120.807	120.807	120.807	120.807	120.807	120.807	120.807
EX-FACTORY PRD.COST	0	0	323.582	354.887	363.059	371.231	379.403	379.403	379.403
UNIT DIRECT COST	0.00000	0.00000	963.04084	739.34859	756.37359	773.39859	790.42359	790.42359	790.42359
SUPERVISION	0	0	36.150	0	0	0	0	0	0
SALES EXPENSE	0	0	4.939	7.056	7.056	7.056	7.056	7.056	7.056
OVERHEAD	0	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000
MUNICIPAL TAX	0	0	2.058	3.352	3.528	3.528	3.528	3.528	3.528
INTR.ON L-TERM DEBT	0	0	157.978	142.180	126.382	110.584	94.787	78.989	63.191
INTR.ON S-TERM DEBT	0	0	0	37.668	27.549	0	0	0	0
PRODUCT COST	0	0	584.707	605.143	587.575	552.400	544.774	528.976	513.178
UNIT PRODCT COST	0.00000	0.00000	1740.19851	1260.71441	1224.11464	1150.83285	1134.94581	1102.03377	1069.12173

Table 15-4 (Case B) (Continued)

PRODUCTION COST STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
PRODUCTIN VOLUME	480	480	480
SAWDUST	480	480	480
ELECTRICITY	480	480	480
BAG	480	480	480
KEROSENE	480	480	480
MATERIALS VOLUME	1.920	1.920	1.920
DETAILS OF MATERIAL			
SAWDUST	8.832	8.832	8.832
ELECTRICITY	10.320	10.320	10.320
BAG	47.328	47.328	47.328
KEROSENE	37.872	37.872	37.872
RAW MATERIALS COST	104.352	104.352	104.352
BY-PRODUCT CREDITS	0	0	0
VARIABLE COST TOTAL	104.352	104.352	104.352
MAINTENANCE	56.172	56.172	56.172
LABOR	82.242	82.242	82.242
INSURANCE	15.830	15.830	15.830
FIXED COST TOTAL	154.244	154.244	154.244
DEPRCI. & AMOTIZAT.	105.700	105.700	105.700
EX-FACTORY PRD.COST	364.296	364.296	364.296
UNIT DIRECT COST	758.95091	758.95091	758.95091
SUPERVISION	0	0	0
SALES EXPENSE	7.056	7.056	7.056
OVERHEAD	60.000	60.000	60.000
MUNICIPAL TAX	3.528	3.528	3.528
INTR.ON L-TERM DEBT	47.393	31.596	15.798
INTR.ON S-TERM DEBT	0	0	0
PRODUCT COST	482.274	466.476	450.678
UNIT PRODCT COST	1004.73702	971.82498	938.91294

Table 15-5 PRODUCT COST IN SELECTED YEARS (Case A)

(%)

	1988 1st year	1989 2nd year	1990 3rd year	1992 Middle year	1997 Last year
Operation Rate	70.0	100.0	100.0	100.0	100.0
Variable Cost	13.7	19.3	20.1	20.3	23.4
Fixed Cost					
Depr. & Amort.	22.7	22.3	23.3	23.5	23.8
Maintenance Labor Insurance	24.4	23.9	26.6	30.1	34.6
Supervision Sales Expense Overhead Municipal Tax	19.4	13.0	13.7	13.8	15.8
Interest on Loan	19.8	21.5	16.3	12.3	2.4
Total	100.0	100.0	100.0	100.0	100.0

Table 15-6 PRODUCT COST IN SELECTED YEARS (Case B)

(%)

	1988 1st year	1989 2nd year	1990 3rd year	1992 Middle year	1997 Last year
Operation Rate	70.0	100.0	100.0	100.0	100.0
Variable Cost	12.5	17.2	17.8	19.2	23.2
Fixed Cost					
Depr. & Amort.	20.7	20.0	20.6	22.2	23.4
Maintenance Labor Insurance	22.2	21.4	23.4	28.3	34.2
Supervision Sales Expense Overhead Municipal Tax	17.6	11.6	12.0	13.0	15.7
Interest on Loan	27.0	29.8	26.2	17.3	3.5
Total	100.0	100.0	100.0	100.0	100.0

Table 15-7 (Case A)

INCOME STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
PRODUCTION & SALES									
CAPACITY	0	0	480	480	480	480	480	480	480
CAP. UTILIZATION	0	0	70	100	100	100	100	100	100
PRODUCTION VOLUME	0	0	336	480	480	480	480	480	480
INC.INVENTORY(VOL)	0	0	56	24	0	0	0	0	0
INC.INVENTORY(AMT)	0	0	82.320	35.280	0	0	0	0	0
SALES VOLUME	0	0	280	456	480	480	480	480	480
UNIT SALES PRICE	0.00000	0.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000
SALES REVENUE	0	0	411.600	670.320	705.600	705.600	705.600	705.600	705.600
TOTAL COST OF SALES	0	0	269.651	337.143	363.059	371.231	379.403	379.403	379.403
VARIABLE COST TOTAL	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
SAWDUST	0	0	6.182	8.832	8.832	8.832	8.832	8.832	8.832
ELECTRICITY	0	0	7.224	10.320	10.320	10.320	10.320	10.320	10.320
BAG	0	0	33.130	47.328	47.328	47.328	47.328	47.328	47.328
KEROSENE	0	0	26.510	37.872	37.872	37.872	37.872	37.872	37.872
CREDIT OF BY-PROD.	0	0	0	0	0	0	0	0	0
FIXED COST TOTAL	0	0	250.535	250.535	258.707	266.879	275.051	275.051	275.051
DEPRICIATION	0	0	112.540	112.540	112.540	112.540	112.540	112.540	112.540
AMOTIZATION	0	0	8.267	8.267	8.267	8.267	8.267	8.267	8.267
MAINTENANCE	0	0	31.656	31.656	39.828	48.000	56.172	56.172	56.172
LABOR	0	0	82.242	82.242	82.242	82.242	82.242	82.242	82.242
INSURANCE	0	0	15.830	15.830	15.830	15.830	15.830	15.830	15.830
INC.INVENTORY(PROD)	0	0	-53.930	-17.744	0	0	0	0	0
PROFIT ON SALES	0	0	141.949	333.177	342.541	334.369	326.197	326.197	326.197
SUPERVISION	0	0	36.150	0	0	0	0	0	0
SALES EXPENSE	0	0	4.939	7.056	7.056	7.056	7.056	7.056	7.056
OVERHEAD	0	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000
MUNICIPAL TAX	0	0	2.058	3.352	3.528	3.528	3.528	3.528	3.528
OPERATING PROFIT	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
INTEREST BENEFIT	0	0	0	0	0	0	0	0	0
TOTAL PROFIT	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
INT.ON LONG TERM D.	0	0	105.310	94.787	84.255	73.723	63.191	52.659	42.127
ON SHORT TERM D	0	0	0	21.870	0	0	0	0	0
NET PROFIT BFR.TAX	0	0	-66.517	146.113	187.702	190.062	192.422	202.053	213.485
INCOME TAX	0	0	0	0	0	0	0	70.478	74.164
NET PROFIT AFT.TAX	0	0	-66.517	146.113	187.702	190.062	192.422	132.475	139.321

Table 15-7 (Case A) (Continued)

INCOME STATEMENTS

PHIL. P. A. CARBON (US$ |)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
PRODUCTION & SALES			
CAPACITY	480	480	480
CAP. UTILIZATION	100	100	100
PRODUCTION VOLUME	480	480	480
INC.INVENTORY(VOL)	0	0	0
INC.INVENTORY(AMT)	0	0	0
SALES VOLUME	480	480	480
UNIT SALES PRICE	1470.00000	1470.00000	1470.00000
SALES REVENUE	705.600	705.600	705.600
TOTAL COST OF SALES	364.296	364.296	364.296
VARIABLE COST TOTAL	104.352	104.352	104.352
SAWDUST	8.832	8.832	8.832
ELECTRICITY	10.320	10.320	10.320
BAG	47.328	47.328	47.328
KEROSENE	37.872	37.872	37.872
CREDIT OF BY-PROD.	0	0	0
FIXED COST TOTAL	259.944	259.944	259.944
DEPRICIATION	97.434	97.434	97.434
AMOTIZATION	8.267	8.267	8.267
MAINTENANCE	56.172	56.172	56.172
LABOR	82.242	82.242	82.242
INSURANCE	15.830	15.830	15.830
INC.INVENTORY(PROD)	0	0	0
PROFIT ON SALES	341.304	341.304	341.304
SUPERVISION	0	0	0
SALES EXPENSE	7.056	7.056	7.056
OVERHEAD	60.000	60.000	60.000
MUNICIPAL TAX	3.528	3.528	3.528
OPERATING PROFIT	270.720	270.720	270.720
INTEREST BENEFIT	0	0	0
TOTAL PROFIT	270.720	270.720	270.720
INT.ON LONG TERM D.	31.596	21.064	10.532
ON SHORT TERM D	0	0	0
NET PROFIT BFR.TAX	239.124	249.656	260.188
INCOME TAX	83.138	86.824	90.510
NET PROFIT AFT.TAX	155.986	162.832	169.678

Table 15-8 (Case B)

INCOME STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
PRODUCTION & SALES									
CAPACITY	0	0	480	480	480	480	480	480	480
CAP. UTILIZATION	0	0	70	100	100	100	100	100	100
PRODUCTION VOLUME	0	0	336	480	480	480	480	480	480
INC. INVENTORY(VOL)	0	0	56	24	0	0	0	0	0
INC. INVENTORY(AMT)	0	0	82.320	35.280	0	0	0	0	0
SALES VOLUME	0	0	280	456	480	480	480	480	480
UNIT SALES PRICE	0.00000	0.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000	1470.00000
SALES REVENUE	0	0	411.600	670.320	705.600	705.600	705.600	705.600	705.600
TOTAL COST OF SALES	0	0	269.651	337.143	363.059	371.231	379.403	379.403	379.403
VARIABLE COST TOTAL	0	0	73.046	104.352	104.352	104.352	104.352	104.352	104.352
SAWDUST	0	0	6.182	8.832	8.832	8.832	8.832	8.832	8.832
ELECTRICITY	0	0	7.224	10.320	10.320	10.320	10.320	10.320	10.320
BAG	0	0	33.130	47.328	47.328	47.328	47.328	47.328	47.328
KEROSENE	0	0	26.510	37.872	37.872	37.872	37.872	37.872	37.872
CREDIT OF BY-PROD.	0	0	0	0	0	0	0	0	0
FIXED COST TOTAL	0	0	250.535	250.535	258.707	266.879	275.051	275.051	275.051
DEPRICIATION	0	0	112.540	112.540	112.540	112.540	112.540	112.540	112.540
AMOTIZATION	0	0	8.267	8.267	8.267	8.267	8.267	8.267	8.267
MAINTENANCE	0	0	31.656	31.656	39.828	48.000	56.172	56.172	56.172
LABOR	0	0	82.242	82.242	82.242	82.242	82.242	82.242	82.242
INSURANCE	0	0	15.830	15.830	15.830	15.830	15.830	15.830	15.830
INC. INVENTORY(PROD)	0	0	-53.930	-17.744	0	0	0	0	0
PROFIT ON SALES	0	0	141.949	333.177	342.541	334.369	326.197	326.197	326.197
SUPERVISION	0	0	36.150	0	0	0	0	0	0
SALES EXPENSE	0	0	4.939	7.056	7.056	7.056	7.056	7.056	7.056
OVERHEAD	0	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000
MUNICIPAL TAX	0	0	2.058	3.352	3.528	3.528	3.528	3.528	3.528
OPERATING PROFIT	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
INTEREST BENEFIT	0	0	0	0	0	0	0	0	0
TOTAL PROFIT	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
INT. ON LONG TERM D.	0	0	157.978	142.180	126.382	110.584	94.787	78.989	63.191
ON SHORT TERM D	0	0	0	37.668	27.549	0	0	0	0
NET PROFIT BFR. TAX	0	0	-119.176	82.921	118.025	153.200	160.826	176.624	192.422
INCOME TAX	0	0	0	0	0	0	0	61.263	66.792
NET PROFIT AFT. TAX	0	0	-119.176	82.921	118.025	153.200	160.826	115.361	125.630

Table 15-8 (Case B) (Continued)

INCOME STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
PRODUCTION & SALES			
CAPACITY	480	480	480
CAP. UTILIZATION	100	100	100
PRODUCTION VOLUME	480	480	480
INC. INVENTORY(VOL)	0	0	0
INC. INVENTORY(AMT)	0	0	0
SALES VOLUME	480	480	480
UNIT SALES PRICE	1470.00000	1470.00000	1470.00000
SALES REVENUE	705.600	705.600	705.600
TOTAL COST OF SALES	364.296	364.296	364.296
VARIABLE COST TOTAL	104.352	104.352	104.352
SAWDUST	8.832	8.832	8.832
ELECTRICITY	10.320	10.320	10.320
BAG	47.328	47.328	47.328
KEROSENE	37.872	37.872	37.872
CREDIT OF BY-PROD.	0	0	0
FIXED COST TOTAL	259.944	259.944	259.944
DEPRICIATION	97.434	97.434	97.434
AMOTIZATION	8.267	8.267	8.267
MAINTENANCE	56.172	56.172	56.172
LABOR	82.242	82.242	82.242
INSURANCE	15.830	15.830	15.830
INC. INVENTORY(PROD)	0	0	0
PROFIT ON SALES	341.304	341.304	341.304
SUPERVISION	0	0	0
SALES EXPENSE	7.056	7.056	7.056
OVERHEAD	60.000	60.000	60.000
MUNICIPAL TAX	3.528	3.528	3.528
OPERATING PROFIT	270.720	270.720	270.720
INTEREST BENEFIT	0	0	0
TOTAL PROFIT	270.720	270.720	270.720
INT.ON LONG TERM D.	47.393	31.596	15.798
ON SHORT TERM D	0	0	0
NET PROFIT BFR.TAX	223.326	239.124	254.922
INCOME TAX	77.609	83.138	88.667
NET PROFIT AFT.TAX	145.718	155.986	166.255

Table 15-9 (Case A)

FUNDS FLOW STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
SOURCE OF FUNDS	0	1.823.548	242.462	387.842	392.764	384.592	376.420	376.420	376.420
CASH FROM OPERATION	0	0	159.609	383.577	392.764	384.592	376.420	376.420	376.420
PROFIT BFR.TAX & I.	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
DEPRECIATION	0	0	112.540	112.540	112.540	112.540	112.540	112.540	112.540
AMOTIZATION	0	0	8.267	8.267	8.267	8.267	8.267	8.267	8.267
FINANCIAL RESOURCES	0	1.823.548	72.901	0	0	0	0	0	0
SHARE CAPITAL	0	507.067	0	0	0	0	0	0	0
LONG TERM DEBT	0	1.316.481	0	0	0	0	0	0	0
SHORT TERM DEBT	0	0	72.901	0	0	0	0	0	0
INCR.IN ACCT PAYAB.	0	0	9.952	4.265	0	0	0	0	0
USES OF FUNDS	0	1.733.082	332.928	363.823	218.843	205.371	194.839	184.307	244.254
INV. IN FIXED ASSET	0	1.733.082	0	0	0	0	0	0	0
LAND & SITE IMPROV.	0	67.376	0	0	0	0	0	0	0
CONSTRUC.FACILITIES	0	765.889	0	0	0	0	0	0	0
MACHINERY.EQUIPMENT	0	817.149	0	0	0	0	0	0	0
PRE-OPERATION EXP.	0	82.668	0	0	0	0	0	0	0
INC.IN CURRENT AST.	0	0	95.961	42.618	2.940	0	0	0	0
INC.ACCT RECEIVABLE	0	0	34.300	21.560	2.940	0	0	0	0
INC.IN PRODUCTION	0	0	53.930	17.744	0	0	0	0	0
INC.IN MATERIALS	0	0	7.731	3.313	0	0	0	0	0
DEBT SERVICES	0	0	236.967	321.206	215.903	205.371	194.839	184.307	173.776
REPAY. L-TERM DEBT	0	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648
REPAY. S-TERM DEBT	0	0	0	72.901	0	0	0	0	0
INT.ON L-TERM DEBT	0	0	105.319	94.787	84.255	73.723	63.191	52.659	42.127
INT.ON S-TERM DEBT	0	0	0	21.870	0	0	0	0	0
INCOME TAX PAYMENT	0	0	0	0	0	0	0	0	70.478
DIVIDENDS PAYMENT	0	0	0	0	0	0	0	0	0
CASH INCREASED	0	90.466	-90.466	24.019	173.921	179.221	181.581	192.113	132.166
BEGINNING CASH BAL.	0	0	90.466	0	24.019	197.940	377.161	558.741	750.854
ENDING CASH BALANCE	0	90.466	0	24.019	197.940	377.161	558.741	750.854	883.020

Table 15-9 (Case A) (Continued)

FUNDS FLOW STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
SOURCE OF FUNDS	376.420	376.420	376.420
CASH FROM OPERATION	376.420	376,420	376.420
PROFIT BFR.TAX & I.	270.720	270.720	270.720
DEPRECIATION	97.434	97.434	97.434
AMOTIZATION	8.267	8.267	8.267
FINANCIAL RESOURCES	0	0	0
SHARE CAPITAL	0	0	0
LONG TERM DEBT	0	0	0
SHORT TERM DEBT	0	0	0
INCR.IN ACCT PAYAD.	0	0	0
USES OF FUNDS	237.408	235.850	229.004
INV. IN FIXED ASSET	0	0	0
LAND & SITE IMPROV.	0	0	0
CONSTRUC.FACILITIES	0	0	0
MACHINERY.EQUIPMENT	0	0	0
PRE-OPERATION EXP.	0	0	0
INC.IN CURRENT AST.	0	0	0
INC.ACCT RECEIVABLE	0	0	0
INC.IN PRODUCTION	0	0	0
INC.IN MATERIALS	0	0	0
DEBT SERVICES	163.244	152.712	142.180
REPAY. L-TERM DEBT	131.648	131.648	131.648
REPAY. S-TERM DEBT	0	0	0
INT.ON L-TERM DEBT	31.596	21.064	10.532
INT.ON S-TERM DEBT	0	0	0
INCOME TAX PAYMENT	74.164	83.138	86.824
DIVIDENDS PAYMENT	0	0	0
CASH INCREASED	139.012	140.570	147.416
BEGINNING CASH BAL.	883.020	1.022.032	1.162.603
ENDING CASH BALANCE	1.022.032	1.162.603	1.310.019

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Table 15-10 (Case B)

FUNDS FLOW STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
SOURCE OF FUNDS	0	1.823.548	295.121	479.674	392.764	384.592	376.420	376.420	376.420
CASH FROM OPERATION	0	0	159.609	383.577	392.764	384.592	376.420	376.420	376.420
PROFIT BFR.TAX & I.	0	0	38.801	262.769	271.957	263.785	255.613	255.613	255.613
DEPRECIATION	0	0	112.540	112.540	112.540	112.540	112.540	112.540	112.540
AMOTIZATION	0	0	8.267	8.267	8.267	8.267	8.267	8.267	8.267
FINANCIAL RESOURCES	0	1.823.548	125.560	91.832	0	0	0	0	0
SHARE CAPITAL	0	507.067	0	0	0	0	0	0	0
LONG TERM DEBT	0	1.316.481	0	0	0	0	0	0	0
SHORT TERM DEBT	0	0	125.560	91.832	0	0	0	0	0
INCR.IN ACCT PAYAB.	0	0	9.952	4.265	0	0	0	0	0
USES OF FUNDS	0	1.733.082	385.587	479.674	380.351	242.233	226.435	210.637	256.102
INV. IN FIXED ASSET	0	1.733.082	0	0	0	0	0	0	0
LAND & SITE IMPROV.	0	67.376	0	0	0	0	0	0	0
CONSTRUC.FACILITIES	0	765.889	0	0	0	0	0	0	0
MACHINERY.EQUIPMENT	0	817.149	0	0	0	0	0	0	0
PRE-OPERATION EXP.	0	82.668	0	0	0	0	0	0	0
INC.IN CURRENT AST.	0	0	95.961	42.618	2.940	0	0	0	0
INC.ACCT RECEIVABLE	0	0	34.300	21.560	2.940	0	0	0	0
INC.IN PRODUCTION	0	0	53.930	17.744	0	0	0	0	0
INC.IN MATERIALS	0	0	7.731	3.313	0	0	0	0	0
DEBT SERVICES	0	0	289.626	437.056	377.411	242.233	226.435	210.637	194.839
REPAY. L-TERM DEBT	0	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648
REPAY. S-TERM DEBT	0	0	0	125.560	91.832	0	0	0	0
INT.ON L-TERM DEBT	0	0	157.978	142.180	126.382	110.584	94.787	78.989	63.191
INT.ON S-TERM DEBT	0	0	0	37.668	27.549	0	0	0	0
INCOME TAX PAYMENT	0	0	0	0	0	0	0	0	61.263
DIVIDENDS PAYMENT	0	0	0	0	0	0	0	0	0
CASH INCREASED	0	90.466	-90.466	0	12.413	142.359	149.985	165.783	120.318
BEGINNING CASH BAL.	0	0	90.466	0	0	12.413	154.772	304.757	470.540
ENDING CASH BALANCE	0	90.466	0	0	12.413	154.772	304.757	470.540	590.858

Table 15-10 (Case B) (Continued)

FUNDS FLOW STATEMENTS

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
SOURCE OF FUNDS	376.420	376.420	376.420
CASH FROM OPERATION	376,420	376,420	376,420
PROFIT BFR.TAX & I.	270.720	270.720	270.720
DEPRECIATION	97,434	97.434	97,434
AMOTIZATION	8,267	8.267	8.267
FINANCIAL RESOURCES	0	0	0
SHARE CAPITAL	0	0	0
LONG TERM DEBT	0	0	0
SHORT TERM DEBT	0	0	0
INCR.IN ACCT PAYAB.	0	0	0
USES OF FUNDS	245.833	240.852	230.584
INV. IN FIXED ASSET	0	0	0
LAND & SITE IMPROV.	0	0	0
CONSTRUC.FACILITIES	0	0	0
MACHINERY.EQUIPMENT	0	0	0
PRE-OPERATION EXP.	0	0	0
INC.IN CURRENT AST.	0	0	0
INC.ACCT RECEIVABLE	0	0	0
INC.IN PRODUCTION	0	0	0
INC.IN MATERIALS	0	0	0
DEBT SERVICES	179.041	163.244	147.446
REPAY. L-TERM DEBT	131,648	131.648	131.648
REPAY. S-TERM DEBT	0	0	0
INT.ON L-TERM DEBT	47,393	31.596	15.798
INT.ON S-TERM DEBT	0	0	0
INCOME TAX PAYMENT	66.792	77.609	83.138
DIVIDENDS PAYMENT	0	0	0
CASH INCREASED	130.587	135.568	145.836
BEGINNING CASH BAL.	590.858	721.445	857.013
ENDING CASH BALANCE	721.445	857.013	1.002.849

Table 15-11 (Case A)

B A L A N C E   S H E E T

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
ASSETS	0	1.823.548	1.708.236	1.654.065	1.710.119	1.768.532	1.829.306	1.900.611	1.911.970
CURRENT ASSETS	0	90.466	95.961	162.597	339.458	518.679	700.260	892.373	1.024.539
CASH	0	90.466	0	24.019	197.940	377.161	558.741	750.854	883.020
ACCT. RECEIVABLE	0	0	34.300	55.860	58.800	58.800	58.800	58.800	58.800
PRODUCTS INVENTO.	0	0	53.930	71.675	71.675	71.675	71.675	71.675	71.675
MATERIALS INVENT.	0	0	7.731	11.044	11.044	11.044	11.044	11.044	11.044
FIXED ASSETS	0	1.733.082	1.733.082	1.733,082	1.733.082	1.733.082	1.733.082	1.733.082	1.733.082
LAND	0	67.376	67.376	67.376	67.376	67.376	67.376	67.376	67.376
CONST.FACILITIES	0	765.889	765.889	765.889	765.889	765.889	765.889	765.889	765.889
MACHINERY.EQUIPM.	0	817.149	817.149	817.149	817.149	817.149	817.149	817.149	817.149
PRE-OPERATION EXP	0	82.668	82.668	82,668	82,668	82.668	82.668	82.668	82.668
DEPREC. & AMOTIZ.	0	0	-120.807	-241.615	-362.422	-483.229	-604.036	-724.844	-845.651
LIABILITY & EQUITY	0	1.823.548	1.708.236	1.654.065	1.710.119	1.768.532	1.829.306	1.900.611	1.911.970
LIABILITIES	0	1.316.481	1.267.686	1,067.402	935.754	804.106	672.458	611.288	483.326
CURRENT LIABILITY	0	131.648	214.501	145.866	145.866	145.866	145.866	216.344	220.030
ACCONTS PAYABLE	0	0	9.952	14.218	14.218	14.218	14.218	14.218	14.218
INCOME TAX PAYABLE	0	0	0	0	0	0	0	70.478	74.164
REF.(CURRENT DEBT)	0	131.648	204.549	131.648	131.648	131.648	131.648	131.648	131.648
LONG TERM DEBT	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648	131.648
SHORT TERM DEBT	0	0	72.901	0	0	0	0	0	0
FIXED LIABILITIES	0	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944	263.296
L-TERM DEBT BLNC.	0	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944	263.296
STOCK HOLDERS EQUI.	0	507.067	440.550	586.662	774.364	964.426	1.156.847	1.289.323	1.428.644
SHARE CAPITAL	0	507.067	507.067	507.067	507.067	507.067	507.067	507.067	507.067
RETAINED ERNINGS	0	0	-66.517	79.595	267.297	457.359	649.780	782.256	921.577
NET PROFIT AFT. TAX	0	0	-66.517	146.113	187.702	190.062	192.422	132.475	139.321
BEGINNING BALANCE	0	0	0	-66.517	79.595	267.297	457.359	649.780	782.256
EARNED SURPLUS	0	0	-66.517	79.595	267.297	457.359	649.780	782.256	921.577
DIVIDENDS PAYABLE	0	0	0	0	0	0	0	0	0

Table 15-11 (Case A) (Continued)

B A L A N C E   S H E E T

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
ASSETS	1.945.282	1.980.152	2.021.867
CURRENT ASSETS	1.163.551	1.304.121	1.451.538
CASH	1.022.032	1.162.603	1.310.019
ACCT. RECEIVABLE	58.800	58.800	58.800
PRODUCTS INVENTO.	71.675	71.675	71.675
MATERIALS INVENT.	11.044	11.044	11.044
FIXED ASSETS	1,733.082	1.733.082	1.733.082
LAND	67.376	67.376	67.376
CONST.FACILITIES	765.889	765.889	765.889
MACHINERY.EQUIPM.	817.149	817.149	817.149
PRE-OPERATION EXP	82.668	82.668	82.668
DEPREC. & AMOTIZ.	-951.351	-1.057.052	-1.162.752
LIABILITY & EQUITY	1.945.282	1.980.152	2.021.867
LIABILITIES	360.652	232.690	104.728
CURRENT LIABILITY	229.004	232.690	104.728
ACCONTS PAYABLE	14.218	14.218	14.218
INCOME TAX PAYABLE	83.138	86.824	90.510
REF.(CURRENT DEBT)	131.648	131.648	0
LONG TERM DEBT	131.648	131.648	0
SHORT TERM DEBT	0	0	0
FIXED LIABILITIES	131.648	0	0
L-TERM DEBT BLNC.	131.648	0	0
STOCK HOLDERS EQUI.	1.584.630	1.747.462	1.917.140
SHARE CAPITAL	507.067	507.067	507.067
RETAINED ERNINGS	1.077.563	1.240.395	1.410.073
NET PROFIT AFT. TAX	155.986	162.832	169.678
BEGINNING BALANCE	921.577	1.077.563	1.240.395
EARNED SURPLUS	1.077.563	1.240.395	1.410.073
DIVIDENDS PAYABLE	0	0	0

Table 15-12 (Case B)

B A L A N C E   S H E E T

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1986 (1)	1987 (1)	1988 (1)	1989 (1)	1990 (1)	1991 (1)	1992 (1)	1993 (1)	1994 (1)
ASSETS	0	1.823.548	1.708.236	1.630.046	1.524.591	1.546.144	1.575.321	1.620.297	1.619.808
CURRENT ASSETS	0	90.466	95.961	138.579	153.931	296.291	446.276	612.059	732.377
CASH	0	90.466	0	0	12.413	154.772	304.757	470.540	590.858
ACCT. RECEIVABLE	0	0	34.300	55.860	58.800	58.800	58.800	58.800	58.800
PRODUCTS INVENTO.	0	0	53.930	71.675	71.675	71.675	71.675	71.675	71.675
MATERIALS INVENT.	0	0	7.731	11.044	11.044	11.044	11.044	11.044	11.044
FIXED ASSETS	0	1.733.082	1.733.082	1.733.082	1.733.082	1.733.082	1.733.082	1.733.082	1.733.082
LAND	0	67.376	67.376	67.376	67.376	67.376	67.376	67.376	67.376
CONST.FACILITIES	0	765.889	765.889	765.889	765.889	765.889	765.889	765.889	765.889
MACHINERY.EQUIPM.	0	817.149	817.149	817.149	817.149	817.149	817.149	817.149	817.149
PRE-OPERATION EXP	0	82.668	82.668	82.668	82.668	82.668	82.668	82.668	82.668
DEPREC. & AMOTIZ.	0	0	-120.807	-241.615	-362.422	-483.229	-604.036	-724.844	-845.651
LIABILITY & EQUITY	0	1.823.548	1.708.236	1.630.046	1.524.591	1.546.144	1.575.321	1.620.297	1.619.808
LIABILITIES	0	1.316.481	1.320.345	1.159.234	935.754	804.106	672.458	602.073	475.954
CURRENT LIABILITY	0	131.648	267.160	237.697	145.866	145.866	145.866	207.129	212.658
ACCONTS PAYABLE	0	0	9.952	14.218	14.218	14.218	14.218	14.218	14.218
INCOME TAX PAYABLE	0	0	0	0	0	0	0	61.263	66.792
REF.(CURRENT DEBT)	0	131.648	257.208	223.480	131.648	131.648	131.648	131.648	131.648
LONG TERM DEBT	0	131.648	131.648	131.648	131.648	131.648	131.648	131.648	131.648
SHORT TERM DEBT	0	0	125.560	91.832	0	0	0	0	0
FIXED LIABILITIES	0	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944	263.296
L-TERM DEBT BLNC.	0	1.184.833	1.053.185	921.537	789.889	658.241	526.592	394.944	263.296
STOCK HOLDERS EQUI.	0	507.067	387.891	470.812	588.837	742.037	902.863	1.018.224	1.143.854
SHARE CAPITAL	0	507.067	507.067	507.067	507.067	507.067	507.067	507.067	507.067
RETAINED ERNINGS	0	0	-119.176	-36.255	81.770	234.970	395.796	511.157	636.787
NET PROFIT AFT. TAX	0	0	-119.176	82.921	118.025	153.200	160.826	115.361	125.630
BEGINNING BALANCE	0	0	0	-119.176	-36.255	81.770	234.970	395.796	511.157
EARNED SURPLUS	0	0	-119.176	-36.255	81.770	234.970	395.796	511.157	636.787
DIVIDENDS PAYABLE	0	0	0	0	0	0	0	0	0

Table 15-12 (Case B) (Continued)

B A L A N C E   S H E E T

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

YEAR	1995 (1)	1996 (1)	1997 (1)
ASSETS	1.644,694	1.674.561	1.714.697
CURRENT ASSETS	862.963	998.531	1.144.368
CASH	721.445	857.013	1.002.849
ACCT. RECEIVABLE	58.800	58.800	58.800
PRODUCTS INVENTO.	71.675	71.675	71.675
MATERIALS INVENT.	11.044	11.044	11.044
FIXED ASSETS	1.733.082	1,733,082	1.733,082
LAND	67.376	67.376	67,376
CONST.FACILITIES	765.889	765.889	765.889
MACHINERY.EQUIPM.	817.149	817.149	817.149
PRE-OPERATION EXP	82.668	82.668	82.668
DEPREC. & AMOTIZ.	-951.351	-1.057.052	-1.162.752
LIABILITY & EQUITY	1.644.694	1.674.561	1.714.697
LIABILITIES	355.122	229.004	102.885
CURRENT LIABILITY	223.474	229.004	102.885
ACCONTS PAYABLE	14.218	14.218	14.218
INCOME TAX PAYABLE	77.609	83.138	88.667
REF.(CURRENT DEBT)	131.648	131.648	0
LONG TERM DEBT	131.648	131.648	0
SHORT TERM DEBT	0	0	0
FIXED LIABILITIES	131.648	0	0
L-TERM DEBT BLNC.	131.648	0	0
STOCK HOLDERS EQUI.	1.289.572	1.445.558	1.611.813
SHARE CAPITAL	507.067	507.067	507.067
RETAINED ERNINGS	782.505	938.491	1.104.746
NET PROFIT AFT. TAX	145.718	155.986	166.255
BEGINNING BALANCE	636.787	782.505	938.491
EARNED SURPLUS	782.505	938.491	1.104.746
DIVIDENDS PAYABLE	0	0	0

Fig. 15-1 BREAK-EVEN POINT (Case A)

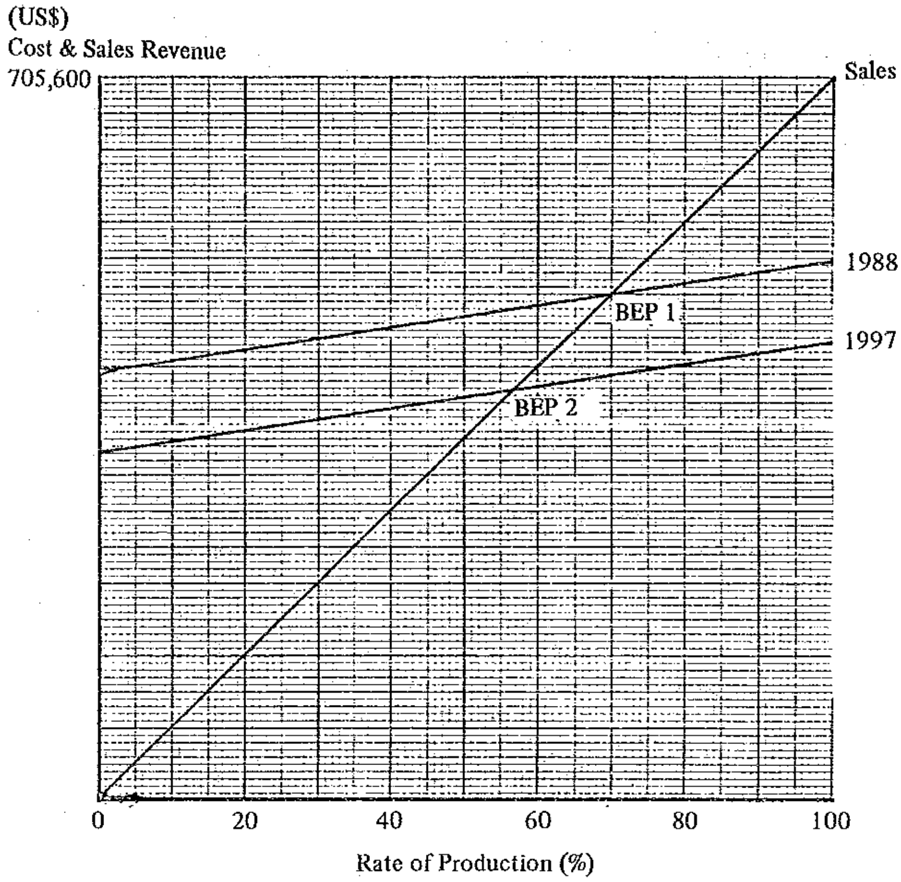


Fig. 15-2 BREAK-EVEN POINT (Case B)

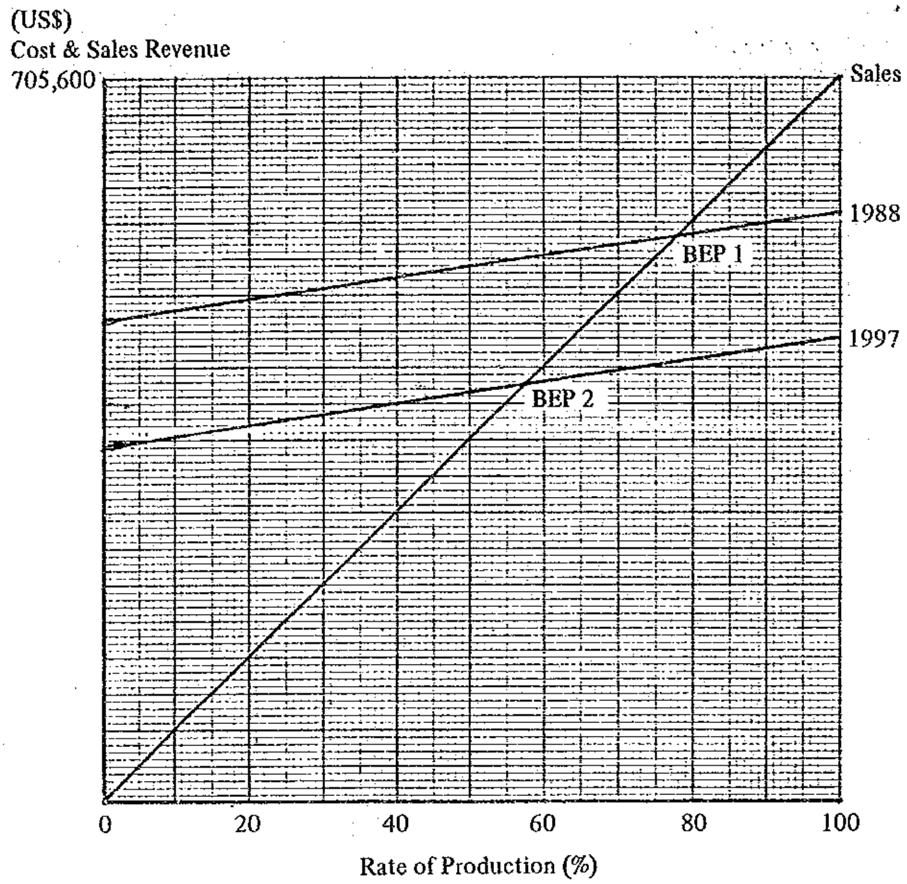


Table 15-13 (Case A)

IRR CALCULATION TABLE

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

IRR CALCULATION ON TOTAL INVESTMENT (ROI BEFORE TAX)

YEAR	TOTAL INVEST MENT	PROFIT BEFORE TAX	DEPRECI ATION	INTEREST ON DEBT	RETURN BEFORE TAX	DISCOUNT RATIO	PRESENT VALUE INVEST.	PRESENT VALUE RETURN
1986 (1)	0	0	0	0	0	1.00000	0	0
1987 (1)	1823548	0	0	0	0	0.86751	1581949	0
1988 (1)	0	-66517	120807	105319	159609	0.75258	0	120118
1989 (1)	0	146113	120807	94787	361706	0.65287	0	236147
1990 (1)	0	187702	120807	84255	392764	0.56637	0	222450
1991 (1)	0	190062	120807	73723	384592	0.49133	0	188963
1992 (1)	0	192422	120807	63191	376420	0.42624	0	160444
1993 (1)	0	202953	120807	52659	376420	0.36977	0	139187
1994 (1)	0	213485	120807	42127	376420	0.32078	0	120747
1995 (1)	0	239124	105700	31596	376420	0.27828	0	104749
1996 (1)	0	249656	105700	21064	376420	0.24141	0	90871
1997 (1)	-570330	260188	105700	10532	376420	0.20942	-119441	78832
TOTAL	1253218				3557191		1462508	1462508

----- INTERNAL RATE OF RETURN ----- = 15.2722 % P.A.

Table 15-14 (Case A)

IRR CALCULATION TABLE

PHIL. P. A. CARBON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

IRR CALCULATION ON TOTAL INVESTMENT (ROI AFTER TAX)

YEAR	TOTAL INVEST MENT	PROFIT BEFORE TAX	DEPRECI ATION	INTEREST ON DEBT	INCOME TAX	RETURN AFTER TAX	DISCOUNT RATIO	PRESENT VALUE INVEST.	PRESENT VALUE RETURN
1986 (1)	0	0	0	0	0	0	1.00000	0	0
1987 (1)	1823548	0	0	0	0	0	0.88046	1605568	0
1988 (1)	0	-66517	120807	105319	0	159609	0.77522	0	123731
1989 (1)	0	146113	120807	94787	0	361706	0.68255	0	246883
1990 (1)	0	187702	120807	84255	0	392764	0.60096	0	236035
1991 (1)	0	190062	120807	73723	0	384592	0.52912	0	203497
1992 (1)	0	192422	120807	63191	0	376420	0.46587	0	175364
1993 (1)	0	202953	120807	52659	-70478	305942	0.41018	0	125493
1994 (1)	0	213485	120807	42127	-74164	302256	0.36115	0	109161
1995 (1)	0	239124	105700	31596	-83138	293282	0.31708	0	93258
1996 (1)	0	249656	105700	21064	-86824	289596	0.27997	0	81079
1997 (1)	-570330	260188	105700	10532	-90510	285910	0.24650	-140589	70478
TOTAL	1253218					3152077		1464979	1464979

----- INTERNAL RATE OF RETURN ----- = 13.5765 % P.A.

Table 15-15 (Case B)

IRR CALCULATION TABLE

PHIL. P. A. CARBON (US$ ( ))
ACCOUNTING DATE --- MONTH (3) DATE (31)

IRR CALCULATION ON TOTAL INVESTMENT (ROI BEFORE TAX)

YEAR	TOTAL INVEST MENT	PROFIT BEFORE TAX	DEPRECI ATION	INTEREST ON DEBT	RETURN BEFORE TAX	DISCOUNT RATIO	PRESENT VALUE INVEST.	PRESENT VALUE RETURN
1986 (1)	0	0	0	0	0	1.00000	0	0
1987 (1)	1823548	0	0	0	0	0.87027	1586983	0
1988 (1)	0	-119176	120807	157978	159609	0.75737	0	120883
1989 (1)	0	82921	120807	142180	345909	0.65912	0	227996
1990 (1)	0	118025	120807	126382	365214	0.57362	0	209493
1991 (1)	0	153200	120807	110584	384592	0.49920	0	191989
1992 (1)	0	160826	120807	94787	376420	0.43444	0	163532
1993 (1)	0	176624	120807	78989	376420	0.37808	0	142318
1994 (1)	0	192422	120807	63191	376420	0.32903	0	123855
1995 (1)	0	223326	105700	47393	376420	0.28635	0	107788
1996 (1)	0	239124	105700	31596	376420	0.24920	0	93805
1997 (1)	-570330	254922	105700	15798	376420	0.21687	-123690	81636
TOTAL	1253218				3513844		1463294	1463294

----- INTERNAL RATE OF RETURN ----- = 14.9066 % P.A.

Table 15-16 (Case B)

IRR CALCULATION TABLE

PHIL. P. A. CARDON (US$ 1)
ACCOUNTING DATE --- MONTH (3) DATE (31)

IRR CALCULATION ON TOTAL INVESTMENT (ROI AFTER TAX)

YEAR	TOTAL INVEST MENT	PROFIT BEFORE TAX	DEPRECI ATION	INTEREST ON DEBT	INCOME TAX	RETURN AFTER TAX	DISCOUNT RATIO	PRESENT VALUE INVEST.	PRESENT VALUE RETURN
1986 (1)	0	0	0	0	0	0	1.00000	0	.0
1987 (1)	1823548	0	0	0	0	0	0.88237	1609037	0
1988 (1)	0	-119176	120807	157978	0	159609	0.77857	0	124267
1989 (1)	0	82921	120807	142180	0	345909	0.68698	0	237634
1990 (1)	0	118025	120807	126382	0	365214	0.60617	0	221383
1991 (1)	0	153200	120807	110584	0	384592	0.53487	0	205705
1992 (1)	0	160826	120807	94787	0	376420	0.47195	0	177650
1993 (1)	0	176624	120807	78989	-61263	315157	0.41643	0	131241
1994 (1)	0	192422	120807	63191	-66792	309628	0.36744	0	113771
1995 (1)	0	223326	105700	47393	-77609	298811	0.32422	0	96881
1996 (1)	0	239124	105700	31596	-83138	293282	0.28608	0	83902
1997 (1)	-570330	254922	105700	15798	-88667	287753	0.25243	-143967	72637
TOTAL	1253218					3136876		1465070	1465070

----- INTERNAL RATE OF RETURN ----- = 13.3316 % P.A.

Fig. 15-3 SENSITIVITY ANALYSIS (Case A)

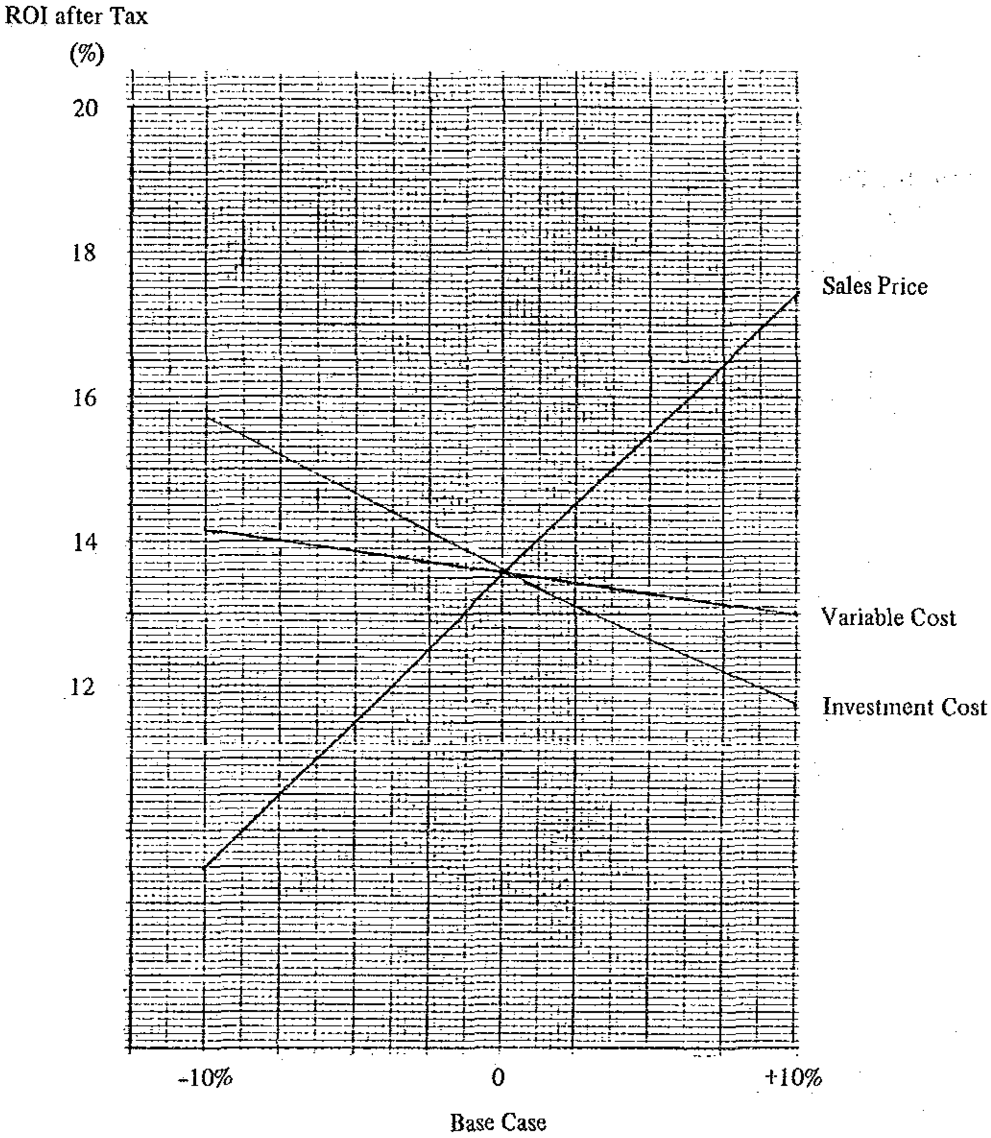
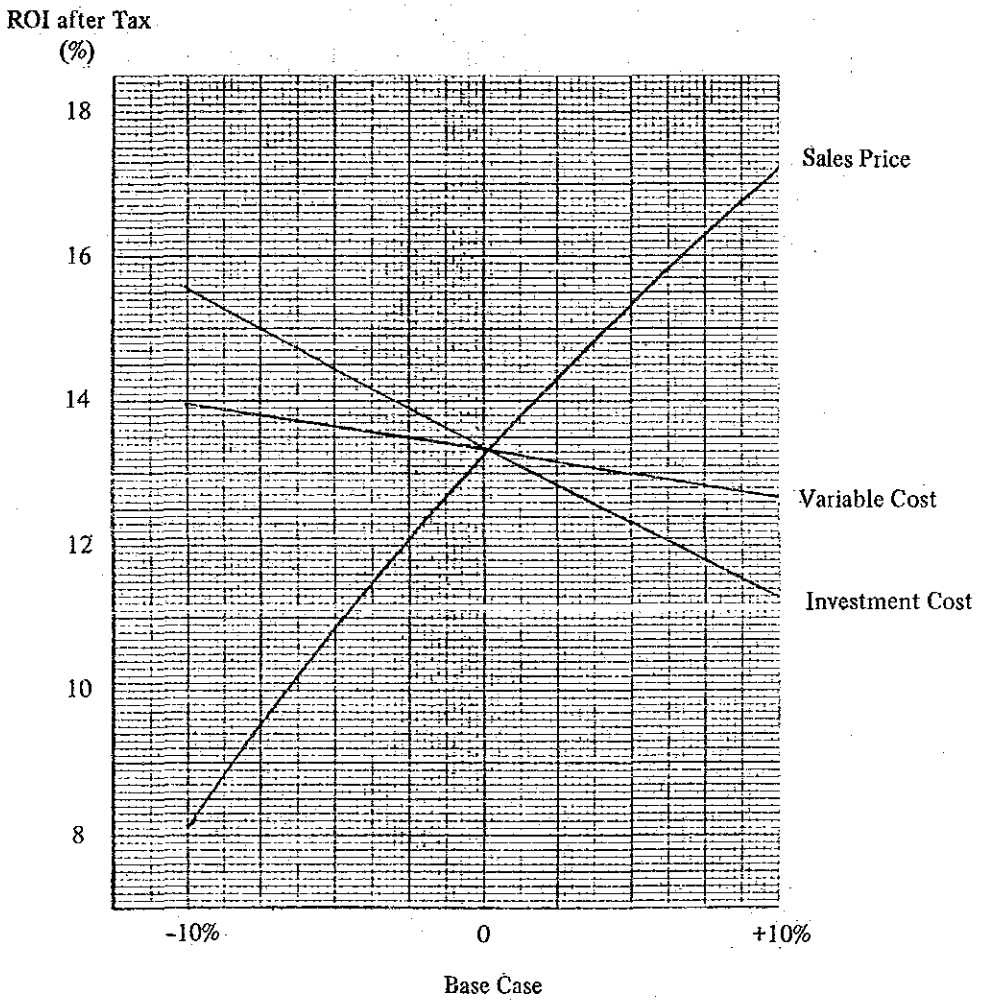


Fig. 15-4 SENSITIVITY ANALYSIS (Case B)



Chapter 16

ECONOMIC EVALUATION

Chapter 16. ECONOMIC EVALUATION

Sawdust that is being generated in huge quantities by sawmills in the Philippines is presently being disposed of almost entirely without being put to any useful purpose. Disposal of sawdust is already raising environmental pollution problems, and there is a great probability of the situation to be aggravated in the years ahead.

The purpose of this project is to manufacture quality powdered activated carbon by using sawdust existing in this situation as the raw material, while at the same time conserving foreign currency by replacing imported powdered activated carbon with part of the manufactured product and exporting part of the product in order to acquire foreign currency.

16.1 Economic Benefits of the Project

This project provides both direct economic benefits and indirect economic benefits.

16.1.1 Direct Economic Benefits

The direct benefits of this project lie in the economic benefits provided by the manufactured powdered activated carbon. That is, the powdered activated carbon produced through this project is partly sold on the domestic market to replace its imported counterparts, thereby conserving foreign currency. Meanwhile, the remaining portion of the product is exported to foreign markets, by which foreign currency is acquired.

1) Economic Internal Rate of Return

In calculating the economic internal rate of return, the following shadow rates were adopted:

Foreign currency:	1.20
Labor cost for unskilled workers:	0.81
Others:	1.00

The foreign currency shadow rates shown above were applied not only to the expenses for imported machinery and equipment but as well to the selling price of the product for the reason that the product is an import substitute, also an export item.

By adopting these conditions and calculating the economic internal rate of return, the following results are obtained:

EIRR 20.85% (Case A)
EIRR 20.68% (Case B)

2) Foreign Currency Earned

Carrying out this project will demand repayment of principal and interest on long-term loan as well as payment of foreign currency for importing repair parts for plant maintenance.

On the other hand, selling the product on the domestic market will replace imported products, and exporting the product to foreign markets will enable acquisition of foreign currency.

In this economic evaluation, the product's ex-factory selling price for the domestic market was conceived as conserved foreign currency. The sum of this amount of conserved foreign currency and the amount of foreign currency acquired through product export will be the total foreign currency income.

Accordingly, the difference between the amount of foreign currency payments and the amount of foreign currency income will be the amount of foreign currency earned through the effectuation of this project. Table 16-1 and Table 16-2 show these calculations.

According to the results of these calculations, the amount of foreign currency earned (based on prices as of April 1987) will be as follows:

US$5,012,871 (Case A)
US$4,772,932 (Case B)

16.1.2 Indirect Economic Benefits

Carrying out this project will provide the following indirect economic benefits:

Table 16-1

OUTFLOW OF FOREIGN CURRENCY BY THE EXECUTION OF THE PROJECT

(Case A)

(US$)

	Repayment of Principal	Interest	Total	Discount Factor (5%)	Present Value (Cost, 1987)	Imported Parts (Cost, 1987)	Total Outflow (Cost, 1987)
1987				1.0			
1988	131,648	105,319	236,967	0.9524	225,687	16,343	
1989	131,648	94,787	226,435	0.9070	205,377	16,343	
1990	131,648	84,255	215,903	0.8638	186,497	24,515	
1991	131,648	73,723	205,371	0.8227	168,959	32,686	
1992	131,648	63,191	194,839	0.7835	152,656	40,858	
1993	131,648	52,659	184,307	0.7462	137,530	40,858	
1994	131,648	42,127	173,775	0.7107	123,502	40,858	
1995	131,648	31,596	163,244	0.6768	110,484	40,858	
1996	131,648	21,064	152,712	0.6446	98,438	40,858	
1997	131,648	10,532	142,180	0.6139	87,284	40,858	
Total					1,496,414	335,035	1,831,449

Total Outflow: US$1,831,449 (Value in 1987)

Table 16-1 (Continued)
INFLOW OF FOREIGN CURRENCY BY THE EXECUTION OF THE PROJECT
(Case A)

(US$)

	Sales Revenue (Value, 1987)
1987	
1988	411,600
1989	670,320
1990	705,600
1991	705,600
1992	705,600
1993	705,600
1994	705,600
1995	705,600
1996	705,600
1997	823,200
Total	6,844,320

Total Inflow US$6,844,320 (Value in 1987)

Total Outflow US$1,831,449 (Value in 1987)

Net Inflow US$5,012,871 (Value in 1987)

Table 16-2

OUTFLOW OF FOREIGN CURRENCY BY THE EXECUTION OF THE PROJECT

(Case B)

(US$)

	Repayment of Principal	Interest	Total	Discount Factor (5%)	Present Value (Cost, 1987)	Imported Parts (Cost, 1987)	Total Outflow (Cost, 1987)
1987				1.0			
1988	131,648	157,978	289,626	0.9524	275,840	16,343	
1989	131,648	142,180	273,828	0.9070	248,362	16,343	
1990	131,648	126,382	258,030	0.8638	222,886	24,515	
1991	131,648	110,584	242,233	0.8227	199,285	32,686	
1992	131,648	94,787	226,435	0.7835	177,412	40,858	
1993	131,648	78,989	210,637	0.7462	157,177	40,858	
1994	131,648	63,191	194,839	0.7107	138,472	40,858	
1995	131,648	47,393	179,041	0.6768	121,175	40,858	
1996	131,648	31,596	163,244	0.6446	105,227	40,858	
1997	131,648	15,798	147,446	0.6139	90,517	40,858	
Total					1,736,353	335,035	2,071,388

Total Outflow: US$2,071,388 (Value in 1987)

Table 16-2 (Continued)

INFLOW OF FOREIGN CURRENCY BY THE EXECUTION OF THE PROJECT

(Case B)

(US$)

	Sales Revenue (Value, 1987)
1987	
1988	411,600
1989	670,320
1990	705,600
1991	705,600
1992	705,600
1993	705,600
1994	705,600
1995	705,600
1996	705,600
1997	823,200
Total	6,844,320

Total Inflow US$6,844,320 (Value in 1987)

Total Outflow US$2,071,388 (Value in 1987)

Net Inflow US$4,772,932 (Value in 1987)

1) Expansion of Employment Opportunities

The following employment opportunities will be created through implementation of this project:

a) Employment at time of plant construction
b) Employment for plant operation
c) Employment for product transportation

2) Economic Effect Provided to Regional Society

Various kinds of industries are presently operating in the Davao region, and carrying out this project will contribute to the development of the Davao region.

3) Prevention of Environmental Pollution

Sawdust is presently being disposed of in huge quantities in various regions and raising environmental pollution problems in some of these regions. Implementation of this project will consume large quantity of sawdust, with the result that environmental pollution by sawdust disposal will be decreased in direct proportion to the quantity in which sawdust is consumed through this project.

16.2 Observation and Evaluation

By manufacturing powdered activated carbon utilizing sawdust as the raw material, which is presently being disposed of without being utilized and therefore valueless, it is possible to conserve and earn large amount of foreign currency.

Based on the results of economic analysis, this project is judged feasible from the economic view-point.

Chapter 17

CONCLUSION

Chapter 17. CONCLUSION

It is concluded that this project is feasible as observed from the technical, financial and economic aspects of the study.

This project can be implemented with a small amount of investment and can provide profits within a short period of time after commencement of plant operation. In addition, carrying out this project will be highly significant even as observed from the aspect of promoting the development of small- and medium-scale industries.

Chapter 18

POINTS OF ISSUE AND RECOMMENDATIONS FOR IMPLEMENTATION OF THE PROJECT

Chapter 18. POINTS OF ISSUE AND RECOMMENDATIONS FOR IMPLEMENTATION OF THE PROJECT

This is a project to manufacture high quality powdered activated carbon by using sawdust that is presently being disposed of without being put to any useful purpose. The product is to replace the imported powdered activated carbon and to acquire foreign currency through export of the product. Therefore, this is a highly significant project of the Philippines. However, the following points are involved.

1. Points of Issue

(a) This project, under the given conditions, appears highly viable as observed from its financial aspects. However, since plant equipment are to be imported and the larger portion of the product is exported, the project will be influenced by the foreign exchange rates.

(b) The larger portion of the product manufactured through this project has to be exported. For this, some measures will be necessary for the product's access into the foreign market.

(c) The product manufactured through this project has to compete favorably with foreign products on foreign markets.

2. Recommendations

In view of the problems described above, the following items are recommended:

(a) In order for the product manufactured through this project to compete favorably with foreign products on export markets, it would be desirable for the product to be given further special promotional incentives from the aspects of taxation.

(b) Since this project provides foreign currency by a small amount of investment and within a short period of time after commencement of plant operation, it will be desirable for the project to be carried out as early as possible.

(c) More than half of the product manufactured through this project is to be exexported. In order to expedite the sale of the product on the foreign market, a business tie-up with a foreign activated carbon manufacturer will be necessary. This will also have the effect of stabilizing the foundation of this project.

(d) In order to operate the plant with stability, training of employees and guidance in plant operation will naturally be necessary. However, these operations will be very costly, and the expenses for long-term guidance may oppress the plant's financial conditions. Even when taking this factor into consideration, a tie-up with a foreign activated carbon manufacturer is considered to be advantageous.

(e) The corporate body carrying out this project may be an official organization, a private corporation or its joint concern. However, as observed from the standpoint of early project execution and brisk corporate activity, the selection of a sawmill as the enforcing entity will be a desirable form. In this case, as it will be possible to utilize the various conveniences possessed by the sawmill, highly advantageous conditions can be obtained in connection with plant construction and operation including raw material procurement.

(f) It is recommended that, in the comercial implementation of the project, NIST gives its assistance to the enterprise/investor/s as requested.

(g) It will be necessary for the plant management to constantly strive to acquire an ever wider scope of knowledge relating to the activated carbon industry as well as industries utilizing activated carbon as a means of expanding the sales market for the product.

APPENDIXES

Implementing Arrangement for Technical Cooperation between Japan International Cooperation Agency and National Institute of Science and Technology

for

Feasibility Study

on

The Establishment of the Powdered Activated Carbon Plants

Agreed upon by

Japan International Cooperation Agency

and

National Institute of Science and Technology

24 March 1983

Mr. Kenji Iwaguchi
Leader, Preliminary Survey Team
Japan International Cooperation Agency

Dr. Quintin L. Kintanar
Officer-in-Charge
Office of the Deputy Director
National Institute of Science and Technology.

I. Introduction

In response to the request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct a Feasibility Study (hereinafter referred to as 'the Study') on the Powdered Activated Carbon Plants within the general framework of technical cooperation between Japan and the Republic of the Philippines, and exchanged the Notes Verbales with the Government of the Republic of the Philippines concerning the implementation of the Study.

The Japan International Cooperation Agency (hereinafter referred to as 'JICA'), the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in force in Japan.

On the part of the Government of the Republic of the Philippines, the National Institute of Science and Technology (hereinafter referred to as 'NIST') shall act as counterpart agency to the Japanese study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

The present document constitutes the implementing arrangements between JICA and NIST under the above-mentioned Notes Verbales exchanged between the two governments.

II. Implementation of the Study

The Study shall be implemented in accordance with the Scope of Work attached herewith (Appendix I).