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SUGAR FACTORY BY-PRODUCT IN INDONESIA

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WORKSHOP ON SUGAR-CANE DIVERSIFICATION
AND MARKET COOPERATION FOR
SELECTED DEVELOPING COUNTRIES
YOGYAKARTA, INDONESIA
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SUGAR FACTORY BY-PRODUCT IN INDONESIA

May, 1994

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Abstract

With the increasing production of cane as raw material of crystal sugar processing, its by-product i.e. molasses and cane bagasse as fuel are also increasing.

Since prewar, sugar industry has developed molasses by-product to be fermented into alcohol/ethanol. The development of domestic processing, from the beginning did not reach the maximum up to the year 1970s, so there were still plenty of molasses that should be exported to Japan, Korea etc.

The development of molasses processing into mono sodium glutamate (MSG), glutamate acid has been done in 1970s by private companies by using technology from Japan, Korea, or Taiwan. So as the ethanol development to be more enhanced. In 1990, L-Lysine product (amino acid) as cattle foods was also developed, and it was still an imported product before.

Under these developments, the amount of exported molasses decreasing from year to year, due to much more molasses processed for domestic requirement.

Further development is planned for substitution of imported product such as acetic acid, acetone, ethyl acetate, buthyl acetate and octanol could be realized.

Development of the use of waste product, bagasse, is directed to be processed into pulp, paper, furfural, particle board and electricity energy as well as compost (mixture of filter cake, boiler ash and bagasse).

Generally, constraints faced in developing either molasses or cane bagasse are marketing, the high investment capital as well as the limitation of qualified human recource.

Necessary efforts made for realising the plan are among others, enhancing the factory efficiency, so it will result in strengthening the fund, enough excess bagasse, and upgrading human resource through training either in country or abroad, as well as absorbing the effective and efficient technology.

1. INTRODUCTION

By the development of sugarcane plantation area of either through the Intensification Program of Farmers Cane (TRI i.e. Tebu Rakyat Intensifikasi) or new sugar factory development with the HGU (the right of land use) land, the sugarcane production will increse from year to year, and so the production of by-product and solid waste that are cane molasses and cane bagasse.

Conventionally, cane molasses is mostly exported to Japan, Korea, Taiwan or to Europe, while the remaining is for domestic marketing, to be processed into alcohol. Cane bagasse is mainly used as fuel and the excess bagasse used for other products such as pulp, paper, and mushroom media.

New technology develcpment in Indonesia is able to process molasses into glutamate acid (GA) and mono sodium glutamate (MSG) well, so that the domestic use of molasses increasing. The development of MSG Industry enhancing from year to year with good marketing of either domestic or abroad. Foactory is now not in full capacity yet, so that if the factory is in optimal capacity operation, the whole cane molasses production will be locally absorbed thoroughly.

In domestic marketing of molasses to MSG, ethanol, glutamate acid factories, the sugar companies are not bound to MSG factory and are independent to free marketing of their molasses, so that an amount of molasses is still exported, due to not to be a 100 percent used in the country.

The excess bagasse is mostly used for paper factory (Pabrik Kertas Leces), and mushroom factory, while the use of excess bagasse for biomass energy, electricity and particle board is still in study stage. Effort to process cane bagasse into furfural is still being undertook.

2. PRODUCTION AND THE USE OF MOLASSES

By the increasing capacities of cane molasses processing factories in Indonesia, the trend of the amount of exported molasses tends to decrease, except in 1986, while the domestic use of molasses is increasing, it is appeared in Table 1.

Table 1.: Production and the Use of Molasses in 1981 - 1992 (In Tonnes)

Year	Production	Eksport	%	Domestic Use for the molasses Processing Factory	%	Miscella-neous	%
1	2	3	4	5	6	7	8
1981	493,824	255,873	51.81	120.075	24.32	117.876	23.87
1982	659,405	481,326	72.99	178,079	27.01	-	-
1983	718.192	513,760	91.54	244,170	34.00	120,000	16.71
1984	785,020	590.528	75.22	207,287	26.41	(12.795)	(1.63)
1985	869,995	577.022	66.32	224.009	25.75	68.964	7.93
1986	918.992	714.712	77.77	268.988	29.27	(64,708)	(7.04)
1987	1,105,560	624,780	56.51	324,187	29.32	156,593	14.16
1988	1,029.206	540.211	52.49	483.211	47.44	784	0.08
1989	1,079.103	447,491	41.47	646.136	59.88	(14.524)	(1.35)
1990	1.181,549	623.141	52.74	717,924	60.76	(159.516)	(13.5)
1991	1,237,687	385,827	31.17	854.376	69.03	(2.516)	(0.20)
1992	1,364,345	554,911	40.67	1,017.000	74.54	(207.566)	(15.21)

Molasses production separated in Java and Outer Java from 1989 up to 1993 indicated by Table 2.

Table 2.: Production of Molasses in 1989 - 1993 (In Tonnes)

Year	Java	Outer Java	Total
1	2	3	4
1989	772,203	306,900	1,079,103
1990	837,649	343,900	1,181,549
1991	876,187	361,500	1,237,687
1992	975,545	388,800	1,364,345
1993	1,002,160	415,200	1,417,360

Source : Kantor Administrasi Hasil Gula, Jakarta
i.e. Administration Office of Sugar Production

3. CAPACITY AND PRODUCTION OF THE CANE MOLASSES PROCESSING FACTORY

In Indonesia, cane molasses is processed into ethanol/ alcohol, glutamate acid and MSG (Mono Sodium Glutamate), single cell protein (SCP) and L-Lysine.

Ethanol factory is not operating in full capacity yet, it is 61.2 percent only in 1988. This case is probably due to marketing problems, while the supply of raw material is no problem.

The MSG and glutamate acid factories using cane molasses raw material are not also in operation in full capacities yet, reaching only 53.53 percent and 52.3 percent respectively in 1988.

In the following table 3 and 4, the factory design capacities with its production (actual capacities) in 1992 and 1988 could be indicated.

Table 3.: Capacity and Production of Ethanol Factories In 1992

No.	Company	Capacity (KL/Year)	Production (KL)	Production % Capacity
1	2	3	4	5
1	PT. Basis Indah	5,500	1,992 *)	36.2
2	PT. Madubaru	4,000	2,535	63.4
3	PT. Aneka Kimia	16,000	15,019	93.9
4	PT. Starsaco	3,600	-	-
5	PT. Permata Sari	5,220	8,766 *)	167.9
6	PT. Molindo Raya	4,000	10,980	274.5
7	PT. Palimanan	4,925	6,265	127.2
8	PT. Madusari Murni	5,850	13,904	237.7
9	PT. Comal	5,700	1,743	30.6
10	PT. Jatiroto	7,500	5,128	68.4
11	PT. Nabati Sarana	1,800	-	-
12	PT. Padahardja	2,000	-	-
13	PT. Indo Acidatama	19,260	35,912	186.5
14	PT. Liem S. Dewi	-	56	-
	TOTAL	85,355	102,300	119.9

Source : Badan Kerja Sama (BKS) Alkohol Indonesia
i.e. Indonesian Coordinating Board of Alcohol
KL : Kilo Liter
*) In 1991

Table 4.: Capacity and Production Mono Sodium Glutamate (MSG) Factory In 1988

No.	Product	Company	Capacity (Tonnes)	Production (Tonnes)	Production % Capacity
1	2	3	4	5	6
1	Mono Sodium	PT. Indo Vetsin	1,200	1,200	100.0
2	Glutamate	PT. Palur Raya	12,000	3,250	27.1
3	(MSG)	PT. Foomsco	1,800	1,500	83.3
4		PT. Sasa Inti	24,100	17,500	72.6
5		PT. Sasa Fermentasi	3,600	4,592	127.6
6		PT. Ajinomoto	18,400	13,032	70.8
7		PT. Miwon Indo.	24,000	15,600	65.0
8		PT. Indo Mide	6,800	5,000	62.5
9		PT. Kota Jaya	3,600	-	-
10		PT. Ajinex Int.	18,000	-	-
		Total	111,500	59,674	53.5
11		PT. Palur Raya	12,700	2,826	22.3
12		PT. Sasa Inti	24,000	19,210	80.0
13		PT. Ajinomoto	24,000	16,290	67.9
14		PT. Miwon Indo	24,000	15,650	65.0
15		PT. Ajinex Int	18,000	-	-
		Total	102,700	53,926	52.5

Source : Asosiasi Pabrik Penyedap Makanan Indonesia
i.e. Association of Indonesian Foods Flavor Factories

4. PLANNING OF THE USE OF MOLASSES

As we know, that the use of molasses by-product has been well developed into ethanol, cattle foods (single cell protein), glutamate acid, mono sodium glutamate (MSG), and L-Lysine as well as acetic acid by privates companies.

4.1. Ethanol Derivative

Ethanol derivative product could be seen in table 5. Acetic Acid could be used as raw material to produce PTA (Pure Terepthalic Acid). A chemistry factory for Pure Terepthalic Acid (PTA) will be erected in Serang, West Java. The factory will produce textile raw material i.e. polyester fiber with the capacity of 250,000 tonnes is planned to spend Rp 400 billions. This PTA factory will be the second one in Indonesia, after the PTA factory at Plaju with the capacity of 150,000 tonnes and has been in operatin for about two years.

The domestic requirement of PTA is now amounted to 300,000 tonnes/year and estimated to increase about 15 to 20 percent each year.

Purified Terepthalic Acid (PTA) is the main raw material of textile fiber, raw material in producing poly-ethylene the repthalete (PET) used among others to produce plastic products such as bottles and plastic packing. The increasing production and export of textile will increase the domestic PTA requirement. The Indonesia's PTA requirement is now about 225,000 tonnes/year, 150,000 tonnes of which produced in the country, while the rest are imported. The requirement of PTA increasing about 15 percent in average each year.

. The exsisting factory will be extended from 150,000 tonnes to 225,000 tonnes. Thus in 1994, the both factories, will produce about 475,000 tonnes/year. If the domestic production in 1994 exceeds the capacity, the excess production will be exported

Table 5.: Ethanol Derivative

I. DEHYDROGENATION

Ethanol to ethylene and its derivatives :

- PVC - Vinyl chloride
- Ehylene oxyde
  - Non ionic surfactant
  - Poly ether
  - Ethylene glycol

II. OXYDATION AND DEHYDROGENATION

1. Ethanol to acetaldehyde and its derivatives :
   - Penta erythritol
   - Peracetic acid
   - Chloral
   - Chrotonaldehyde
     - Butyraldehyde -> Butyl alcohol
     - 2-Ethyl hexanol -> Octoic acid
   - Acetic Acid
     - Acetamide
     - Vinyl acetate
     - Ethyl acetate
     - Buthyl acetate
     - Anyl acetate
     - Isopropyl acetate
     - Acetic anhydride
     - Cellulose acetic
2. Ethanol to acetone and its derivatives :
   - Diphenylol propane
   - Acetone cyanohidrine -> Methyl methacrylate
   - Diaceto alcohol
     - Methyi - isobutyl carbinol
     - Methyl - isobutyl ketone

III. MODIFICATION

Ethanol modified into :

- Ethyl chloride
- Buta diene
- Ethyl amine
- Diethyl ether
- Chloreform

4.2. Liquid Sugar From Molasses

Process of liquid sugar of sugar cane molasses is devided into pretreatment, separation, product fraction, demineralization, evaporation, final decolorization, and storage of products. Process of pretreatment including reception of thick molasses, dilution, enzymatic inversion of sucrose, centrifugal clarification, filtration and softening. Process of liquid sugar require auxiliary systems, they are, process of water system and steam generation.

The design plant has one chromatographic separation column with 100 cubic meters resin volumes. The daily capacity is 40 tons of molasses dry substance that is about 50 tons liquid weight. Annual balance of liquid sugar production is showed in Table 6.

Table 6.: Annual balance of liquid sugar production

	Liquid weight (t)	DS (%)	DS (t)	Sugar purity (%)
1. Raw materials (cane molasses)	15.000	80	12.000	65
2. Products :				
a. liquid sugar	9,280	75	6.960	99
b. Residual molasses	7,800	70	5.460	16

DS : Density Solid

The main prerequisite of cane molasses content is DS around 80 percent of liquid weight, sucrose minimum 43.5 percent of DS and reducing sugars minimum 21.5 percent of DS.

A liquid sugar plant is better build in connection with an exsisting sugar factory since it is possible to save considerably on investment costs. Estimate of investment including process equipments, freight and transport of process equipments, building and civil work, process equipment installation, auxiliary, contigencies and pre operating expenses. Production cost including utilities, chemical, maintenance and operating personnel.

Table 7.: Estimate of Investment and Production Cost

Investment	US$ 10.873.000
Production cost p.a	US$ 1.700.000

4.3. Sucrose Chemistry

Sucrose is the most abundant organic chemical available in purified from and relatively cheap. The world sugar production in 1990's is more than one hundred and ten million tons per year. The greater parts of the sugar is consumed as food and beverage products. The development of other cheaper potensial sweeteners weakens the bargaining position of sucrose. Effort is needed to strengthen its position by utilizing sucrose as feed stock to produce new and useful compound, that is sucrochemistry.

There are many sucrose derivatives that can be studied and developed with a good prospect, among others fatty acid, sucrose esters, non ionic surfactant used in pharmacy, cosmetic, food and also sugar industry. Biodegradable polimers, viopolymer are among the products that have to be developed urgently, in the near future. Figure 1 shows the possibilities of the utilization of sucrose.

4.4. Acetic Acid, Ethyl Acetate, Acetone etc.

As the follow up of UNIDO's contract No. 89/22/CW with JGC Japan, study out on "Industrial Chemical From Indigenous Carbohydrate in Indonesia" has been carried out in March 1989.

Basically, the study suggested in order to cane molasses as the raw material of ethanol/alcohol to be processed to produce imported product such as acetic acid, ethyl acetate, acetone, buthyl acetate, octanol, n-butanol as well as crude ethanol as solvent. While citric acid product is not promoted due to it has been produced more than local demand and the design capacity of its factory has exceeded. L-Lysine has been produced by PT Cheil Samsung, so that the L-Lysine need for cattle and poultry foods could be fulfilled by the domestic production and probably it could be exported too.

Summary of study and project proposal suggested to be built in East Java using molasses and ethanol raw materials are as follows.

PROJECT SUMMARY

1.	**PRODUCT AND PRODUCTION QUANTITY**		
	(1) Acetic Acid	15,800	tonnes/year
	(2) Ethyl Acetate	18,700	
	(3) Buthyl Acetate	8,000	
	(4) Acetone	8,000	
	(5) n-Butanol	2,200	
	(6) Octanol (2-Ethyl Hexanol)	9,600	
	(7) Crude Ethanol	2,700	
2.	**RAW MATERIAL**		
	(1) Molasses	250,000	tonnes/year
	(2) Ethanol	20,000	
3.	**PRODUCTION CAPACITY OF MAIN PROCESS UNIT**		
	(1) Ethanol	23,000	
	(2) Acetaldehyde	35,000	
	(3) Acetic Acid	20,000	
	(4) Ethyl Acetate	19,000	
	(5) Buthyl Acetate	8,000	
	(6) Acetone/Butanol	27,000	
	(7) Octanol	10,000	
4.	**LOCATION**	East Jawa	
5.	**PLANT CONSTRUCTION COST**	US $ 120	Million
6.	**CONSTRUCTION PERIOD**	2	Year
7.	**EMPLOYMENT**	200	Persons
8.	**ECONOMY**		
	(1) Annual Sales Revenue	US $ 62.7	Million
	(2) Internal Rate of Return (IRR)	17.1	%
	(3) Payout Period	6.7	Years
	(4) Cummulative Surplus Cash	US $ 196	Million
	(5) Foreign Currency Saving (in 15 years)	US $ 319	Million

4.5. Desugarisation

The aim of desugarisation is to improve the quality of molasses produced by sugar factories at the eastern part of the East Java in order to be applicable as raw material at molasses processing factory such as MSG factory.

5. TECHNOLOGY

-- Processing technology of ethanol by fermentation has been self mastered, but the advanced technology such as from Vogel Bush is still imported. The process of MSG production from molasses is mostly undertook by foreign companies, Japan, Korea and Tiwan in cooperation with local companies by using imported technology.

Constraints in the development of biotechnology in molasses processing among others are the limited number of human resources and the amount of investment capital for the limited development too. Besides the constraints, it seems that the limited market and market information are also necessary factors to overcome.

6. CALCULATED COST OF ETHANOL

The cost of 95 percent ethanol at the fixed price in 1993 is estimated to Rp 627.-/liter consisted of direct cost ± Rp 223.-/liter and Rp 404/liter indirect cost. The export price US $ 305/Kl FOB in 1992 and local selling price Rp 925.-/liter.

Production cost information of MSG, GA, acetic acid and furfural is not met yet.

7. WASTE TREATMENT

Since the Environmental Act No. 4, 1982 has been in force, the treatment of the waste of Alcohol and MSG industries etc. is continuously undertook in order to reach quality standard determined by the Government. The successful factory that has processed MSG factory waste into amino fertilizer is Adjinomoto and it should be expected to develop to other MSG factories. While from ethanol waste, various method treatment are carried out among others by anaerob method using metan gas produced and hereinafter by aeration method and its liquid waste is used for irrigation water with BOD content about 900 - 1,500 ppm or is used for others.

8. SUPPLY AND DEMAND OF MOLASSES IN 1989 - 1992

By the development of MSG, acetic acid, and ethanol as well as L-Lysine factories in the country and if the factories are in operation in 100 percent of capacity, in the coming years probably molasses production of sugar factories will be absorbed thoroughly for the domestic molasses processing factories.

Supply and demand of molasses from 1989 up to 1992 could be indicated in the following Table 8.

Table 8.: Supply and Demand of Molasses In 1989 - 1992

Year	Supply (Tonnes)	Industry Demand for						
		GA/MSG	Alcohol	Pellet	Soybean Souce	Yeast	Miscel-laneous	Total **)
1	2	3	4	5	6	7	8	9
1989	1,079,103 772,203 *)	298,352	321,680	5,900	10,700	4,600	6,900	648,132
1990	1,181,549 837,649 *)	304,000	336,400	6,200	11,200	4,800	7,300	669,900
1991	1,237,687 876,187 *)	395,860	371,104	6,500	11,800	5,100	7,600	797,964
1992	1,364,345 975,545	516,360	404,620	6,800	12,400	5,300	8,000	953,480

Source : 1. Sekretariat Dewan Gula Indonesia i.e. Indonesian Sugar Council Secretariat
2. Departemen Perindustrian i.e. Ministry of industry

Note : Molasses demand in 1990 - 1992 based on installed capacity of alcohol and MSG factories
*) Supplied by sugar factories in Java GA : Glutamate Acid
**) The rest of molasses supply is exported

9. CANE BAGASSE

In line with the increasing amount of sugarcane milled from year to year, bagasse production as sugar factory waste product is also increasing. Generally, cane bagasse is used for boiler fuel as an energy resource in sugar factory.

By the increasing efficiency of factory in fuel consuming and the application of economical energy equipment as well as the smooth milling operation, so that in 1980s, many sugar factories had plenty enough excess bagasse.

Since 1978, some sugar factories, especially in East Java have been in cooperation with 'Pabrik Kertas Leces' i.e Leces paper factory that processed sugar factory excess bagasse into paper under a fixed agreement. Recently, however, not the whole excess bagasse could be used for

paper, so that there were excess bagasse in some sugar factories i.e. unsolved problem and precisely as a waste that needed cost to handle. Only some sugar factories in Central Java are able to use excess bagasse for the media of mushroo, and Gunung Madu sugar factory sells excess bagasse to other company in order to be processed into furfural.

Actually, efficiency level of the use of calory/fuel could still be enhanced by the use of steam from 0.6 kg/kg cane to 0.5-0.55 kg/kg cane or there is a 10 percent safing energy of the existing bagasse or about 0.99 million tonnes bagasse per year (sugarcane production in Indonesia is about 33 million tonnes per year with the bagasse content is more than 30 percent). The excess bagasse will be able to be used for electricity that could be sold through cooperation with PLN. The excess bagasse could also be processed into particle board that could be used as furniture equipment as well as partition of a bulding. The both products are still in pre study carried out by sugar companies in Indonesia with USAID's aid and by the sugar companies itselves.

Sugarcane production and the amount of excess bagasse in milling year 1991 and 1992 appeared in attachment 3 and

9.1. Bagasse

9.1.1. Pulp and Paper

In first semester, 1992, the export realization of pulp and paper recorded as 321,181 tonnes valued US $ 184.6 million. From which, pulp export recorded as 50,569 tonnes valued US $ 24.0 million. Wile paper export consisting of

writing paper, newsprint, industrial paper, and tissue paper are amounted to 270,612 tonnes valued US $ 160.6 million.

Export of writing paper amounted to 118,779 tonnes wit its value of US $ 90.0 million, to destination countries incuding Thailand, Bangladesh, Mauritius, Guinea, Hongkong, North Korea, Taiwan, PNG, Singapore, Malaysia, Srilanca, Iran, Saudi Arabia, UEA, Oman, Bahrein, Nikaragua, Australia, Fiji, England, France, Sweden, Canada, India, Germany, Pakistan, New Zealand, Vietnam, USA and Yaman.

Export of newsprint amounted to 10,489 tonnes valued US $ 4.4 million, to destination countries are Singapore, Korea, Malaysia, Vietnem and Srilangca. The industrial paper amounted to 137,773 tonnes valued US $ 62.2 million is exported to Malaysia, Singapore, Taiwan, Australia, Hongkong, Thailand, Srilanca, Saudi Arabia, UEA, Canada, India, England, Bangladesh, RRC, Pakistan, Japan and several other countries. While export of tissue paper reaching 3,571 tonnes valued US $ 4.1 million to Singapore, New Zealand, Malaysia, Australia, Iran, Russia and Taiwan.

Indonesia is now capable to produce and export machineries for paper factory. The Paper factory machineries made in Indonesia have applied sophisticated technology and could produce paper without carbon.

Company that produced paper factory machineries located in Central Java. Nowadays, the company has had an order to erect paper factory in Malaysia covering the works beginning from designing, engineering,factory equipment manufacturing, machineries installation up to production processing trial.

9.1.2. Furfural.

Furfural (a kind of chemical solvent) factory is now under construction, firstly in indonesia. Factory with investment valued Rp 50 billion is planned to produce 10,000 tonnes furfural, 5,500 tonnes furfuril alcohol, 3,000 tonnes tetra hydo furfuril alcohol, 1,000 tonnes acetic acid and 500 tonnes formic acid per year. Half of the production to be exported to Japan and Europe, while the rest is for domestic marketing to fulfill the domestic need.

Raw materials used are cane bagasse and corn stem. The raw materials will be supplied by one of companies that managing sugarcane plantation and sugar factory.

Furfural industry has many chances to develop because of domestic demand is high enough, besides not to be listed in 'Daftar Negatif Investasi' i.e. investment negetive list. Up to now, the Indonesia's furfural need is supplied by Muangthai and RRC.

9.1.3. Composting

Indonesian Sugar Research Institute, Pasuruan is able to produce microorganisms starter for composting, and to design aerotiller which is drived by tractor, and system of transportion and distribution of compost. Raw materials of compost are a mixture of bagasse, filter mud and boiler ash. Estimate of production cost is around Rp. 50/kg or 0,25 US$.

9.1.4. Efforts Made

Efforts to enhance the efficiency of the use of calory/ fuel are among others : the use of efficient equipment such as steam turbine machineries, evaporator with quintiple effect system, or sixtiple effect, much bleeding of evaporator, continuous clarifier of either single tray or multi-trays, medium pressure boiler, etc. In house keeping is also enhaned in order to the smoothness of processing and milling could be more improved so that the use of steam/ calory could be more controlled. For small capacity sugar factories or the factories with capacity of less than 2,000 TCD are necessary considered to be amalgamated, so that its efficiency will be improved.

Measure to improve human resource that handling the sugar factory is more important, however, so that the concern and responsibility to conserve energy could be continuously done.

9.1.5. Constraints to be faced

Constraints faced in processing development of bagasse into electricity, particle board, and furfural are among others investment cost and human resource investment. To process bagasse into furfural, the liquid waste treatment is necessary to be considered, so that environmental factor could be well controlled/maintained.

10. SUGGESTION

Efforts in developing import substitution commodity such as acetic acid, acetone, buthanol, ethyl acetate etc. are necessary to be continuously pushed by all sides so that the efforts could be realized. Molasses processing to improve its quality is seriously needed by the molasses processing factories to enhance its efficiencies as well as to reduce its liquid wastes especially molasses from sugar factories in the eastern part of East Java.

Efforts to develop the use of cane bagasse into electricity are necessary to be continuously encouraged to support the electricity supply in Indonesia. Processing of bagasse into furfural should be provided with liquid waste treatment in order to be able to carry out the envoronmental oriented development.

Yogyakarta, May 1994

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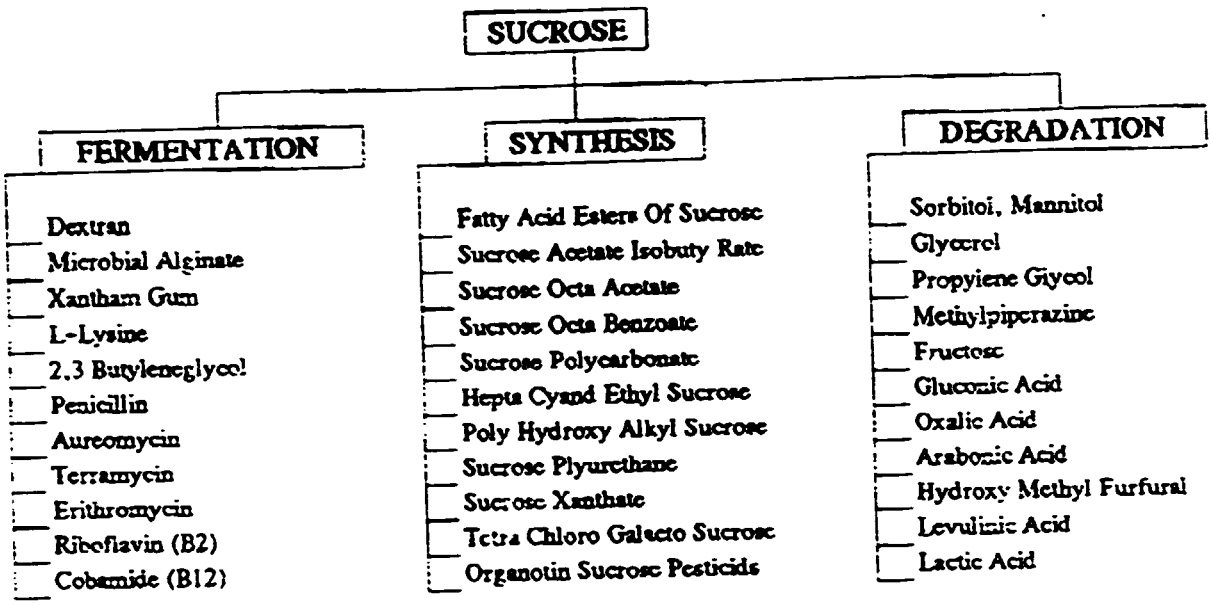
FIGURE 1.: PRODUCT OF SUCROSE OF ACTUAL OR POTENTIAL IMPORTANCE



Symbols Of Main Usage

Food & Feed Improvers
Pharmaceuticals, Cosmetics, Etc
Surfactants, Viscosity Improvers, Etc
Resin Intermediates, Plasticizers, Etc
Surface Coatings, Dielectrics, Pesticides

DERIVATIVE PRODUCT FROM SUGAR FACTORY BY-PRODUCT

No.	Sugar Factory By Product	Derivative Project			Derivative Product			Export of the Country	Domestic Cnsumption
		Product	Tonnes/Year	Price/Ton	Product	Tonnes/Year	Price/Ton	Tonnes/Year	Tonnes/Year
1	2	3	4	5	6	7	8	9	10
1.	Molasses	Ethanol	93,000	$303	Acetic Acid	12,000	$800	74,400/-	18,600/20,000
					Acetone	-	$600 *)	-	6,250
					Ethyl Acetate	-	$1,145 *)	-	20,000
					Buthyl Acetate	-	$1,145 *)	-	6,000
					n-Buthanol	-	$770 *)	-	2,200
					Octanol	-	$1,310 *)	-	960
		Sitric	4,235	Rp.2.31 mil *)	Beverages	NA	NA	2,500	1,700
		MSG	60.000	Rp.2.95 mil *)	Foods	NA	NA	8,000	52,000
		L-Lysine	10,000	± 3,000 US $	Cattle Foods	NA	NA	5,000	5,000
		GA	53,000	± Rp.1.8 mil *)	MSG	NA	NA		53,000
		SCP	NA	NA	Cattle Foods	NA	NA		
				*) data in 1988					
2.	Bagasse	Energy	3.940 million		Electricity		Rp.140,-/kwh		
		Furfural	NA		Solvent	NA			
		Particle Board			House partition				
3.	Cane Leaves	Pellet of Cane leaves/ Trash	2,400 ton/ month	± 150 US$/ ton	Cattle Foods			NA	

Figure 2

Figure 3.: By-Product of the cane sugar industry

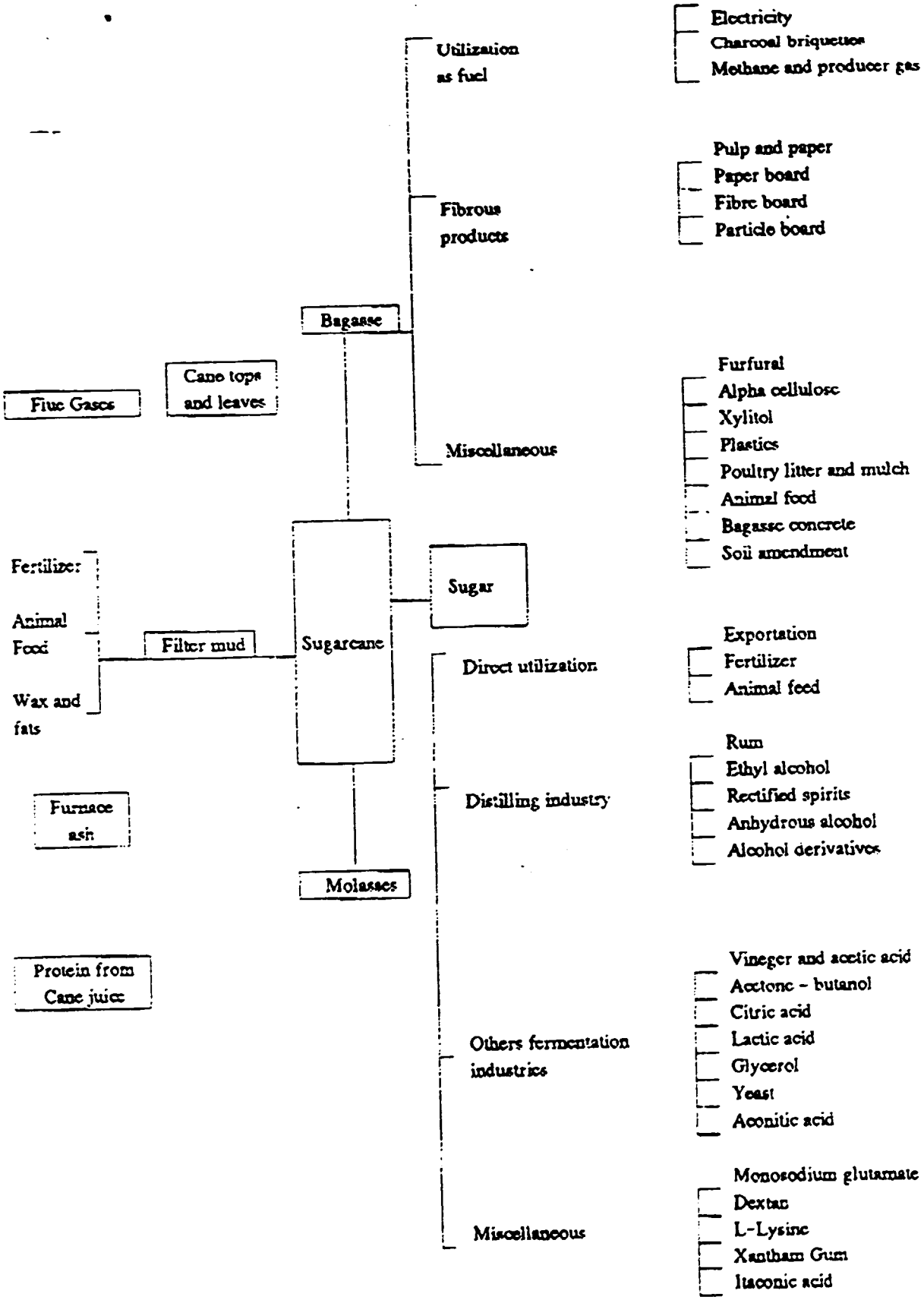


Figure 4

Sugar Factories		Excess Bagasse (Tonnes) up to Last Milling 1992	Excess Bagasse (Tonnes) up to 31 August 1993
JAVA			
I. PT PERKEBUNAN XIV			
1. Kadhipaten SF	(C)	0	5,739
2. Jatiwangi SF	(C)	0	6,509
3. Gempol SF	(C)	0	0
4. Sindanglaut SF		0	4,700
5. Karangsuwung SF		0	47
6. Tersana Baru SF		0	4,714
Ketanggungan Barat Site		0	
7. Jatitujuh SF		0	49,359
8. Subang SF		0	3,858
Total :		0	74,925
II. PT PERKEBUNAN XV-XVI			
9. Banjaratma SF		0	-
10. Jatibarang SF		0	-
11. Pangka SF		0	-
12. Sumberharjo SF		0	-
13. Sragi SF		0	-
14. Cepiring SF	(C)	0	2,857
15. Rendeng SF		0	857
16. Mojo SF		0	6,286
17. Tasikmadu SF	(C)	0	4,286
18. Colomadu SF		0	-
19. Ceper Baru SF	(C)	0	1,145
20. Gondang Baru SF	(C)	0	-
21. Kalibagor SF	(C)	0	-
Total :		0	15,431
III. PT PERKEBUNAN XX			
22. Sudhono SF		0	0
Bojonegoro Site			
23. Purwodadi SF		0	0
24. Rejosari SF		0	0
25. Pagottan SF		0	0
26. Kanigoro SF		0	0
Total :		0	0
IV. PT PERKEBUNAN XXI-XXII			
27. Krian SF		0	3,533
28. Watutulis SF		0	7,337
29. Tulangan SF		0	3,814
30. Kremboong SF		0	857
31. Gempolkrep SF		0	29,904
32. Jombang Baru SF		0	2,207
33. Cukir SF		0	196
34. Lestari SF		0	7,291
35. Merican SF		0	16,877
36. Pesantren Baru SF		0	16,601
37. Ngadirejo SF		0	13,008
38. Mojopanggung SF		0	5,246
Total :		0	106,871

Sugar Factories	Excess Bagasse (Tonnes) up to Last Milling 1992	up to 31 August 1993
V. PT PERKEBUNAN XXIV-XXV		
39. Kedawung SF	521	2,053
40. Wonolangan SF	474	110
41. Gending SF	1,080	0
42. Pajarakan SF	0	0
43. Jatiroto SF	0	0
44. Semboro SF	1,757	2,614
45. De Maas SF	0	394
46. Wringinanom SF	1,486	1,745
47. Glean SF	1,994	1,151
48. Panji SF	171	0
49. Asembagus SF	1,301	80
50. Prajekan SF	64	109
Total :	8,848	8,256
VI. PT BAPIPPUNDIP		
51. Pakis Baru SF	0	46,748
VII. PT KEBON AGUNG		
52. Kebon Agung SF	0	13,119
53. Trangkil SF	0	12,335
Total :	0	25,454
VIII. PT MADU BARU		
54. Madukismo SF	0	2,350
IX. PT RAJAWALI NUSANTARA INDONESIA		
55. Rejoagung Baru SF (C)	0	0
56. Krebet Baru I SF	0	0
Krebet Baru II SF	0	0
Total :	0	0
X. PT PG CANDI		
57. Candi SF	0	0
TOTAL OF JAVA :	8,848	280,036
OUTER JAVA :		
I. PT PERKEBUNAN IX		
1. Kwala Madu SF	0	0
2. Sei Semayang SF	0	0
Total :	0	0
II. PTP XXIV-XXV		
3. Pelaihari SF	0	2,173
III. PT PERKEBUNAN XXXI		
4. Cinta Manis SF	40,300	31,095
5. Bunga Mayang SF	15,050	21,900
Total :	55,350	52,995
IV. PT PERKEBUNAN XXXII		
6. Bone SF	0	872
7. Camming SF	0	2,020
8. Takalar SF	0	1,294
Total :	0	4,186

Sugar Factories	Excess Bagasse (Tonnes) up to Last Milling 1992	Excess Bagasse (Tonnes) up to 31 August 1993
V. PT GUNUNG MADU PLANTATIONS		
9. Gunung Madu SF	0	0
VI. PT GULA PUTIH MATARAM		
10. Gula Putih Mataram SF	0	0
VII. PT NAGA MANIS PLANTATIONS		
11. Paguyaman SF	0	0
TOTAL OF OUTER JAVA :	55,350	59,354
TOTAL OF INDONESIA :	64,198	339,390

Note : (C) – Carbonatation, the others are Sulphitation.