Report on Reevaluation of the 1977 Effluent Limitations for the Hilo-Hamakua Coast of the Island of Hawaii Raw Cane Sugar Processing Subcategory

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ABSTRACT

This report presents the findings of a study of the Hilo-Hamakua Coast raw cane sugar processing subcategory for the purpose of reevaluating the effluent limitations guidelines for the subcategory. The findings are in answer to the notice of suspension at 43 FR 43394, September 25, 1978.

The Agency is recommending revised effluent limitations guidelines for suspended solids control. These are based on the degree of effluent reduction attainable through the application of the best practicable control technology currently available (BPT). This technology includes screening and grit removal, clarification with polymer addition, and settling in a clarifier followed by thickening and land spreading of the settled solids. A series of gravity settling ponds is reported to be a satisfactory alternative.

The study presents the supporting data and rationale for the recommended suspended solids effluent limitations.

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SECTION I

CONCLUSIONS

EPA's review of the available data on waste treatment within the three plants in the Hilo-Hamakua Coast sugar processing subcategory confirmed that the technology originally recommended for the industry is still appropriate. This technology includes end-of-pipe clarification to remove suspended solids, vacuum filtration to dewater the settled sludge, and land spreading to dispose of the thickened sludge.

Review of the data indicates that the original BPT total suspended solids limitations should be revised to better reflect the situation at the Hilo-Hamakua Coast factories. The limitations are based on quantity of gross rather than net cane processed. The use of gross rather than net cane more accurately accounts for the amount of soil and debris brought into the factories with the cane and the impact of the soil and debris on the process wastewater suspended solids loading. The pH of the process wastewaters from the Hilo-Hamakua Coast factories is not being controlled because of insufficient data.

SECTION II

RECOMMENDATIONS

The Agency is recommending revised BPT effluent limitations for the Hilo-Hamakua Coast raw cane sugar processing subcategory based on end-of-pipe treatment of process wastewaters and based on a gross cane measurement of raw material. The BPT technology is already in place at two of the three Hilo-Hamakua plants. An alternative system, in use at the third plant, is expected to be able to attain the revised BPT effluent limitations set forth below.

Effluent Characteristics	Maximum for Any One Day		Average of Daily Values for 30 Consecutive Days Shall Not Exceed	
	kg kkg gross cane	lb 1000 lb gross cane	kg kkg gross cane	lb 1000 lb gross cane
BOD_5	No limitations		No limitations	
TSS	9.9	9.9	3.6	3.6
pH	No limitations		No limitations	

SECTION III

BACKGROUND

On February 27, 1975, EPA promulgated an interim final effluent limitations guidelines regulation for the following raw cane sugar processing subcategories: Louisiana (Subpart D); Florida and Texas (Subpart E); the Hilo-Hamakua Coast of the Island of Hawaii (Subpart F); Hawaii (Subpart G); and Puerto Rico (Subpart H). Simultaneously, the Agency proposed BAT limitations, standards of performance for new sources, and pretreatment standards for existing sources and new sources. A development document for interim final regulation and a supplementary economic analysis of the possible effects of the regulation were issued to supplement the information in the regulation. The Agency requested comments on the two supporting documents.

On January 10, 1977, EPA suspended until March 1, 1978 that part of the interim final BPT regulation pertaining to the Hilo-Hamakua Coast of the Island of Hawaii (Subpart F) so that EPA could reevaluate the technical aspects.

The time frame of this initial suspension was insufficient to complete the data collection and analysis, and on September 25, 1978 the Agency extended the suspension of BPT regulation for this subpart until May 30, 1979.

The EPA has completed its review of all information relating to this matter, including information gathered in field investigations by EPA's National Enforcement Investigations Center and industry submissions.

SECTION IV

CURRENT STUDY

On July 31, 1978, Region IX of the Environmental Protection Agency requested new data from the industry under section 308 of the Clean Water Act. The data was to be used to re-evaluate best practicable technology currently available (BPT).

Industry submitted information covering the development and operation of wastewater treatment facilities. Included were descriptions of the water pollution control facilities, data covering waste treatment performance and operation, and the capital, operation and maintenance costs for water pollution control for the Honokaa Sugar Company, Hamakua Sugar Company (formerly Laupahoehoe Sugar Company), and the Hilo Coast Processing Company, Pepeekeo factory. Data was also provided on the soil and rainfall characteristics for the Hilo-Hamakua Coastal area.

Additional engineering field evaluation reports were completed for this study by the EPA National Enforcement Investigations Center (NEIC) in Denver. These studies detailed plant investigations made by NEIC during the period October 24 through 31, 1977. Compliance monitoring reports and plant visit information also were submitted by Region IX and the Hawaii Department of Health.

SECTION V

WASTEWATER TREATMENT SYSTEMS

Total suspended solids (TSS) was the process wastewater pollutant of most concern in the initial BPT limitations. Two distinct approaches to the treatment of this pollutant have been taken by the three Hilo-Hamakua Coast factories. Two of the mills, Honokaa and Hamakua, now operate treatment systems consisting of preliminary screening and grit removal, followed by clarification in a circular clarifier using polymer flocculent aid. Settled solids from the clarifier flow to two vacuum filters for thickening. Sludge is retained in ponds when solids loadings are too heavy for the vacuum filters to handle. Final treatment consists of land spreading the thickened solids.

The initial treatment design began operating at Honokaa in July 1976 using only one vacuum filter, 10 feet in diameter by 20 feet long. This proved inadequate to handle the settled solids loading produced when the fine screens located ahead of the clarifier failed.

The failed screens were replaced with a mechanical grit separator consisting of a trough through which the wastewater flowed and through which scraper boards passed. The separator can remove about 8 percent of the suspended solids compared with 50 percent removal by the fine screens. With the additional solids passing to the clarifier, the single filter could not handle the loading. By the 1978 growing season, the plant had installed mud ponds to receive underflow from the clarifier to accommdate excessive solids load in the system, and added another vacuum filter to the system. Treatment performance has since been consistently reliable.

Hamakua's treatment system began operating in July, 1977, complete with four auxiliary mud ponds. A second vacuum filter was installed in May, 1978. Treatment performance has been the best of any of the mills.

The Pepeekeo factory took a completely different approach to the treatment of process wastewater. The company has a land treatment and disposal system which consists of large settling ponds assisted by a polymer flocculant aid. Past performance of the system has been unrealiable, largely because of belated mud and silt removals from the ponds and the incorrect location of the flocculant aid feed point. To correct these problems, the plant has expanded the pond system, acquired additional solids handling equipment, and relocated the polymer feed point.

SECTION VI

CANE HARVESTING AND WASTE LOAD

Soil, the principal source of TSS in the wastewater, enters the factory with the harvested cane. The amount of soil brought into the factory is a function of the harvesting methods and rainfall conditions prior to harvesting.

The basic harvesting methods use "push rake" and "V-cutter" bulldozers with heavy rake-like or snow plow-like attachments. These can function in the wettest conditions and in the steepest and rockiest terrain; however, they also pick up large quantities of soil along with the cane. In dryer weather and on relatively level, rock-free terrain, more sophisticated mechanical harvesters can be used. These cut the cane with rotating knives and remove it with much less soil and roots. If the weather is dry, the cane can be burned, further reducing the pick up of cane trash and associated soil. All of these harvesting methods leave rows of piled cane which are subsequently loaded into hauling trucks. A more advanced harvesting method uses a mechanical harvester to cut the cane, clean and chop it into short pieces, and load it into a buggy which is driven alongside the harvester. Cane harvested by this system does not need wet cleaning at the mills. However, numerous technical difficulties have precluded large-scale application. The mechanical harvesters are not usable under wet conditions or on steep or rocky terrain. In addition, push-rakes or V-cutters must clear strips around the borders of the fields to give the harvesters room to maneuver.

Reducing non-millable material in the harvested cane provides the following benefits:

1. reduction in the number of trucks required to haul cane by 50 percent;

2. elimination of cane cleaning, the most expensive factory operation;

3. elimination of sugar losses of 15% or more from cane cleaning;

4. reduction in factory milling costs by at least 50%;

5. elimination of the need to dispose of over one million tons per year of waste material;

6. reduction in power plant maintenance costs; and

7. reduction of maintenance costs, from transportation through sugar storage.

SECTION VII

BASIS FOR BPT LIMITATIONS

Background

The original effluent guidelines study for the Hilo-Hamakua Coast subcategory defined best practicable control technology currently available in the original Development Document, pages 191-192. This technology was based on engineering judgment, technology transfer, and laboratory information developed by the industry. The technology included clarification of the process wastewaters with polymer addition, followed by dewatering of the settled sludge, and disposal of the thickened solids. (Barometric condenser cooling water and excess condensate bypass the treatment system.) The design assumes grit removal, polymer addition and mixing, settling in a heavy-duty clarifier, dewatering sludge by vacuum filtration, and land spreading of the solids.

The use of gravity settling ponds for clarification is an alternative now in use at the third factory. EPA's review has shown that the BPT technology on which the original effluent limitations were based is still acceptable. It is now in use at two of the three Hilo-Hamakua Coast factories and is the basis for the revised guidelines.

The original BPT effluent limitations for the Hilo-Hamakua Coast subcategory were as follows:

Effluent Characteristics	Maximum for Any One Day		Average of Daily Values for 30 Consecutive Days Shall Not Exceed	
	kg kkg net cane	lb 1000 lb net cane	kg kkg net cane	lb 1000 lb net cane
BOD_5	No limitations		No limitations	
TSS	4.2	4.2	2.1	2.1
pH	Within the range 6.0 to 9.0.			

Revised Limitations and Rationale

EPA is revising the BPT effluent limitations for the Hilo-Hamakua Coast subcategory as follows:

Effluent Characteristics	Maximum for Any One Day		Average of Daily Values for 30 Consecutive Days Shall Not Exceed	

	kg / kkg gross cane	lb / 1000 lb gross cane	kg / kkg gross cane	lb / 1000 lb gross cane
BOD5	No limitations		No limitations	
TSS	9.9	9.9	3.6	3.6
pH	No limitations		No limitations	

The revised effluent limitations are less stringent than the original ones, use gross rather than net cane as the production parameter, and do not limit pH.

EPA developed the revised limitations from operating data at the Honokaa and Hamakua factories where BPT is in place. The data came from discharge monitoring reports submitted by the companies and contained in compliance monitoring reports provided by the Hawaii Department of Health. The Agency reviewed records from March through December, 1978, for Honokaa, and July 1977 through December 1978 for Hamakua. Monitoring data for May through December 1978, were considered for Pepeekeo. The expanded ponds began operating in May.

The treatment plant effluent data for the three factories are summarized below.

Honokaa

	TSS (kg/kkg or lb/1000 lb gross cane) Maximum Day	Monthly Average
March, 1978	2.0	1.56
April	7.37	2.96
May	1.61	0.74
June	2.83	0.98
July	2.01	1.53
August	1.21	0.77
September	4.95	2.29
October	2.40	1.57
November	4.00	2.85
December	8.07	5.01

Hamakua

July, 1977	1.04	0.64
August	10.8	2.8
September	0.74	0.51
October	1.4	0.71
November*	1.32	1.13
March, 1978	0.35	0.27
April	0.70	0.54

May	0.75	0.32
June	1.99	0.89
July	4.42	1.4
August	0.5	0.39
September	2.83	1.50
October	2.60	1.42
November	7.83	3.60
December	5.04	2.24

*Consists of a combination of 2 values for Nov., 1 for Dec. and 2 for Feb.; these were the only values reported for these months.

Except for one monthly average and one daily maximum value, all of the values for the two factories are less than the revised limitations. The high monthly average resulted from one unusually high daily value for which no explanation was reported.

Pepeekeo

Rebuilt ponds treating the waste from this factory began operating on April 26, 1978. Several months of effluent data for this system were as follows:

	TSS (kg/kkg or lb/1000 lb gross cane)	
	Maximum Day	Monthly Average
May, 1978	3.85	2.18
June	12.45	5.08
July	9.60	6.17
August	39.16	18.52
September	27.52	12.56
October	35.78	15.64
NOvember	55.69	20.58
December	35.83	19.81

The plant met the revised limitations during the month of May; thereafter, the monthly average and maximum-day values increased and are considerably higher than the revised guidelines. As indicated previously, this system has not operated reliably; however, plant engineering personnel state that when properly operated and maintained, the system achieves average TSS values of 7.15 lb TSS per 1,000 lb of net cane. This is equivalent to meeting the revised BPT limitation of 3.6 lb per 1,000 lb gross cane because gross cane typically is 50 percent debris or more. Under optimum operating conditions, EPA Region IX, NEIC, and State of Hawaii personnel determined that the system produces an effluent quality similar to BPT.

Gross Cane

The Agency has adopted gross cane rather than net cane as the production parameter because it provides a more accurate method of determining effluent loadings. Industry data show variations in the wastage in the gross cane trucked to the factories. These variations regularly occur because of differences in harvesting methods, terrain, soil types, efficiency of cane burning, the use of ripeners and defoliators prior to harvest, operator skill in using infield equipment, and variations in rainfall. This latter point is particularly significant. During periods of high rainfall, records show that soil and debris may comprise as much as 70 percent of the material delivered to the factory.

The use of gross cane as the production parameter takes these conditions into account. Gross cane is weighed upon arrival at the factory, and because it includes both debris and cane, it is more representative than net cane (an estimated quantity) of variations in the amounts of extraneous materials and the attendant waste load imposed on the wastewater treatment facilities. The fluctuations in waste load affect waste treatment plant performance and attendant solids effluent levels. This is the rationale for the gross cane parameter.

pH

The original limitation of pH to between 6 and 9 also was reviewed in this study. Industry comments stressed the fact that the naturally acidic nature of the Hilo-Hamakua Coast plantation soils was responsible for low process wastewater pH values. A study by consultants Sun, Low, Tom, and Hara showed strongly acidic soils in the region of the Hilo-Hamakua Coast plantations, as shown in the following table.

Plantation Soil Type	pH
Akaka	5.5
Hilo	4.3
Honokaa	6.0
Kaiwiki	4.9
Kukaiau	4.5
Ookala	5.0

Paauhou 5.5

Available pH data for the process wastewaters from the Hilo-Hamakua factories were very limited, but demonstrated the acidic nature of the wastewaters. Information from Honokaa and Hamakua covered only a few days of operation. Hamakua reported pH values as low as 5.2, at Honokaa, pH values for five days of operation in 1975 were given as follows:

Date	pH Range
May 19	5.3 - 6.1
May 20	5.9 - 6.6
May 21	5.4 - 6.5
May 22	5.9 - 6.5
May 23	5.4 - 6.9

To modify the naturally occurring pH of the wastewaters would require the addition of an alkaline material such as chemical lime; because of the voluminous quantities of wastewaters involved, raising the pH to the usually accepted minimum of 6 would require large amounts of chemical.

Consideration of these factors convinced the Agency that data were insufficient to set a specific pH limitation. Therefore, the Agency will not promulgate a pH limitation at this time.

SECTION VIII

COSTS

Two of the Hilo-Hamakua Coast factories have BPT technology in-place and in use; the third factory, which uses an alternate gravity pond system, has all the necessary equipment to effect treatment.

EPA has identified the following additional costs for manpower and basic equipment to insure adequate operation and maintenance of the pond system.

	Equipment	Cost*
1.	One D-3 Backhoe tractor to remove silt from ponds (at least one is already in use)	$43,704
	Manpower	
2.	Two additional land containment dredge operators	$37,775

*January 1, 1979 dollars

The costs developed for BPT are listed below and cover the following equipmen secondary screens; clarifier; water pipes; pumping; polymer feed system; vacuum filters; soil conveyance; and storage and trucks. These figures represent costs for a plant with in-place technology but no BPT waste treatment facilities. This is the case for the one Hilo-Coast factory which has substituted a ponding system for the BPT technology. All costs have been adjusted to January 1, 1979 dollars.

Treatment Level	Capital Costs*
BPT (1977)	$1,874,000

Specific equipment costs are as follows:

Secondary screen**	129,600
Clarifier	432,500
Water pipes, pumping, etc.	19,400
Polymer feed system	79,500
Vacuum filters	416,700
Soil Conveyance and Storage	351,400
Trucks	445,000
	1,874,100

* January 1, 1979 dollars
**Secondary screening or some substitute.

Operating Costs*

Secondary Screen Maintenance	2,650
Water Pump Maintenance	390
Polymer Feed System	
- Operation and Maintenance	29,500
- Labor	29,900
Clarifier - O&M	5,800
Vacuum Filters	
- Maintenance	11,600
- Labor	19,800
Soil Conveyance and Storage	
- Maintenance	6,710
Trucks	
- O&M	28,080
- Labor	205,840
Power	15,360
	355,630

Land $0/yr - $31,200/yr.

*January 1, 1979 dollars