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[UPGRADING SUGAR FACTORY OPERATIONS FOR IMPROVED ENERGY UTILIZATION

Presented To The Symposium

[FUELS AND FEEDSTOCKS FROM TROPICAL BIOMASS

Caribe Hilton Hotel, San Juan, Puerto Rico

Novenber 24?and 25, 1980

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CENTER FOR ENERGY AND ENVIRONMENT RESEARCH,

UNIVERSITY OF PUERTO RICO ~ US. EPARTMENT OF ENERGY

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By

Héctor M, Rodefguer - PE

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?UPGRADING SUGAR FACTORY OPERATIONS FOR IMPROVED ENERGY UTILIZATION

Uéctor M. Rodrfguer - PE

Until very recontly sugar mill operators thought of bagasse a8
a necessary evil. It had to be used as inefficiently as possible

so that no money need be spent in getting rid of any excess over and

above boiler firing capacity. Small quantities were stored for use
during mill shut~dovns but othervise any excess was hauled away to

bbe incinerated in some open space outsi:

je the factory grounds. As
the price of energy has escalated in the vake of OPEC oil price rises,

mill operators have become avare of the need of upgrading operations

?20 that any excess energy over that required for sugar processing is not wasted. Changes in field operations have forced sone sugar factories to supplement bagasse with expensive fuel oil in order to ge~erate the power and stean required for-ailling cane and processing

the juice into sugar and nolass

Te is no longer po:

sible to ope-
rate inefficiently and sose sugar producing regions have taken steps to maximize energy efficiency and conservation in their sugar cane industry practices.

In Puerto Rico ost sugar mill boilers are operated at very low

pressures, ranging from 125 to 175 psig. In eo doing, the ability

to tranaforn the heat values in bagasse into usable power is severely curtailed. While it is not possible to attain utility boiler pres-

sures with such a low grade fuel as bagasse, bagasse boilers elsevhere

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?are operated at such higher pressure without using any auxiliary fuels. ?This has been made possible by the use of bagasse dryers using waste heat from plant boiler

In 60 doing they have made possible higher furnace temperatures, less excess air requirements, higher boiler effi-ciency and lover particulate eaissions.

Jn order to illustrate how the thermal balance of a sugar mill

4s affected by these factors, we have looked at a sugar mill processing 7,500 tons of cane per 24 hours under conditions more or less typical of Puerto Rico. We have calculated hov mich surplus electrical energy could be generated under optimum present operating conditions and also with the addition of a bagasse dryer and a high pressure boiler. The dxyer would reduce moisture content of bagasse to 40% and the boiler would be operated at 640 peig and 640°F.T.T. A steam turbo-generator

would utilize the exes

steam under various schemes. The following

?options have been considered:

1, operat

under present conditions, with and without bagasse

dryer, Steam not needed for operations to be utilized by

?neighboring industrial operation or expanded to 4" lig. Abs.

by use of suitable condensing equipnent (Tables 1A and 18;

Figo. 1A and 18).

2. Addition of a high pre

ure boiler and using all bagasse

produced as fuel. Again excess low pressure stean to be

provided to another industrial operation or expanded to 4"

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Hg. Abs. under appropriate conditions (Table IIA and Fig. TIA).

3. Sane as 2 above but burning only the quantity of bagasse re~

?quired for generating 300,000 1bs per hour stean needed for sugar operations; the rest to be stored for off season oper~ ation or sold to others for fuel and/or fiber use (Table TI and Fig, TIB).

Table TIT shows that electric power generation is not signifi- cantly increased by drying the bagasse to 40% moisture content if it is used to produce stean at the low pressures nov prevailing in the ?sugar industry in Puerto Rico. Thus the available power increases only by 18% under optimum conditions. However, if « relatively high Pressure boiler is fired with this 40x wet bagasse, it is possible to increase electrical pover generation up to 128% over the former case.

Tn Case ITB less than half of all che raw bagi

e produced by

the sugar mill is needed to generate all the steam required for fac~

tory operations. This steam is c

able of generating about 8500 Ke

of which 2500 are consuned in house, the balance of 6000 KW are avai-

Jable for sale. The excess

2e may be stored and used to run the

steaa and power aysten during the off-season; producing at least

16,000 KW for sale if enough generating and condensing capacity is

ade available

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CALCULATIONS

General_Information:

Capacity - 7,500 tons cane/24 hrs

Fiter = 188 cane

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faw Bagesse Analysis Fiber 42%

Brix 5

Ash 18

° Moisture 52%

Total Fiber = 7,500 x 0.18 1,350 tons/day

"prix 161 "/day

° ash 2"

Total bry Weight 1,583 tons/day

Total Raw Bagasse 3,214.6 tons/day

Flow Per Hour (Rav) 133.9 tons

° Flow Per Hour (08 wet) 107.2 tons

WMV AOE bagasse - 4,907 eTu/b

HHV 52% bagasse . 3,958 "

OA Boller Efficiency (40%) = 683

o 0A Boiler Efficiency (52%) - 62%

Steam Rate 625 psig to W0psig. = 34.95 bse

Steam Rate 140 psig to 15 psig - = 37.15 1bs/te

Steam Rate 140 psig to 4 iy abs = 19, 84 te/e

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Case I= OPTIMUM CAPACITY WITH LOW PRESSURE BOILERS

Weight

Raw (522) bagasse

Total heat In bagasse

Total heat to steam

Steam flow

Steam for process

Balance for power

Surplus power to 15 psig

Ho HH Hy abs

Ib = Using bagasse dryer

Weight 40% W bagasse =

Total heat in bagasse =

Total heat to steam =

Steam flow -

Steam for process =

Balance for power -

Surplus power to 15 psig =

to MY Hg ak

= 133,3 tons/hr

= 1,060 x 108 stW/he

657 x 10° BTW/hr

= 651. Ibs/hr

= 300 M Ibs/1b

= 351M Ibs/1b

= SHB Ke

-17,682 Ke

107.2 tons /ar

1,060 x 10° Bru/nr

721 x 108 BTU/hr

714M bs/hr

300 4 Ibs/hr

AM bs Zhe

11,18 ie

20,867 ve

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Case 1A ~ HIGH PRESSURE BOILER

Weight Ok W bagasse = 107.2 Tons /or

Heat in bagasse = 1,060 x 108 eru/nr

Heat to steam Tax 108 BTU/hr

Stean flow = 603.8 M Ibs/hr

Surplus Power to 140 psi = 17,276 tle

?A Surplus power to 15 psig = 8,178 Kie

-B Surplus power to 4!" Hg. abs = 15,313 KWe

Case 118 - 300,000 tbs/hr pressure boiler

Steam flow

300,000 Ibs/hr

Surplus power to 140 psig = 8,584 Ke

jasse require - 53.3 tons/hr

Surplus bagasse (402m) - 53.9 tons/he

Equivalent raw (52%w) bagasse

To storage 67.4 x 24

67.4 tons/ne

1,617.6 tons/day

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or) | an NO) SAG

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?TABLE ILI - AVAILABLE POWER

1A

IBA

1A

1-18

Bapate votature £ 2 oo ?©

sean Prensure Fate wo Mo oo

we steam mbes fast eo

to Procens albe/ae | 2000 200

rorower meme | ask atk tk =a

Tower to 15 prig, mie | 9,468 AL,sue 6962544541410

Power to 4"liga, KWe ! 17,692 20,867 $3175 32, #11,722

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