

## WATER PRODUCTION PLANT

By

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**KEYWORDS: Water, Ethanol and Sugar Plants, Stillage.**

### Abstract

FRESH water is becoming one of the most important natural resources in the world. It is fundamental to human beings, for their own consumption, in industries, agricultural irrigation, electrical power production, and also in leisure and amusement activities. For industries, the availability of fresh water may represent a decisive factor in choosing the location of a new enterprise. In the case of Brazilian sugar and ethanol production, sugarcane culture traditionally does not use irrigation, which is an important factor from the environmental viewpoint, because it uses less fresh water, and avoids the entrainment of nutrients and agricultural toxic residues, and soil losses. In sugar and ethanol production, according to average data for the State of São Paulo in 2005, water consumption was 21 m<sup>3</sup> of water/tonne of sugarcane (180 litres per litre of ethanol), and intake of 1.83 m<sup>3</sup> of water/tonne of sugarcane (nearly 22 litres per litre of ethanol). The increasing demands of fresh water consumption and the shortage of this resource on a worldwide level is a concern to several sectors of society, as they are becoming more critical, demanding more responsible attitudes from companies, while the latter endeavour to follow a sustainable development policy to consolidate their companies and their products.

### Introduction

Fresh water is a very precious asset and, as time passes, it becomes scarcer. One cannot imagine life without water. In an industrial society, the need for intensive food production has accelerated the consumption of this resource. Associated with water consumption, large volumes of effluents are generated. The rational use of water has become a question of fundamental importance to the survival of humanity. In its turn, industry is a large water consumer.

For illustrative purposes, according to ABIQUIM, the Brazilian Chemical Association, the use of water in the beer industry is between 15 and 25 L/L beer; for gasoline manufacture, between 7 and 10 L/L gasoline; polyethylene around 231 L/kg polyethylene; paper pulp 300 to 800 L/kg paper pulp and fine paper 900 to 1000 L/kg paper. In the sugar and alcohol industry, water consumption has been reduced, as illustrated by the data in Table 1. Nevertheless, there is a large potential for reduction.

**Table 1**—Survey of water in-take consumption and disposal.

Year uses (m <sup>3</sup> /tc)	1990 <sup>(1)</sup>	1997 <sup>(2)</sup>	2005 <sup>(3)</sup>
In-take	5.6	5.07	1.83
Consumption	1.8	0.92	Not available
Disposal	3.8	4.15	Not available

<sup>(1)</sup> Data from the State water resources plan ('PERH - Plano Estadual de Recursos Hídricos') 1994/95.

<sup>(2)</sup> CTC Survey (Sugar Cane Technology Center), 34 sugar mills in the State of São Paulo.

<sup>(3)</sup> UNICA/ CTC Survey – ('CTC - Centro de Tecnologia Canavieira') in 2005.

As will be demonstrated in the course of this paper, there is an enormous potential in the sugar and alcohol industry for changing from being a water importer to becoming a water exporter.

To get an idea of the production volumes involved in Brazil's sugar and alcohol sector, according to DATAGRO, the 325 plants in operation in the 2006/07 season processed 427 million tonnes of sugarcane, which were cultivated in an area of 5.3 million hectares (8.8% of the arable area in Brazil), producing 18 million cubic metres of bioethanol and 31 million tonnes of sugar. For the production of these volumes of sugar and alcohol, it was necessary to take around 768 million cubic metres of water (1.8 m<sup>3</sup>/t cane) and around 214 million cubic metres of stillage (12 m<sup>3</sup>/m<sup>3</sup> ethanol) and 17 million tonnes of filter cake (40 kg/t cane) were generated.

**Technological options**

**Conventional mill**

A traditional sugar mill normally takes water from rivers, wells and/or reservoirs in the magnitude of 1.0 and 2.0 m<sup>3</sup> of water per tonne of sugar cane processed. When also considering the amount of water contained in the cane, which is typically 70% of the cane mass, then the total amount of water available is 2530 kg/tonne of cane (Figure 1).

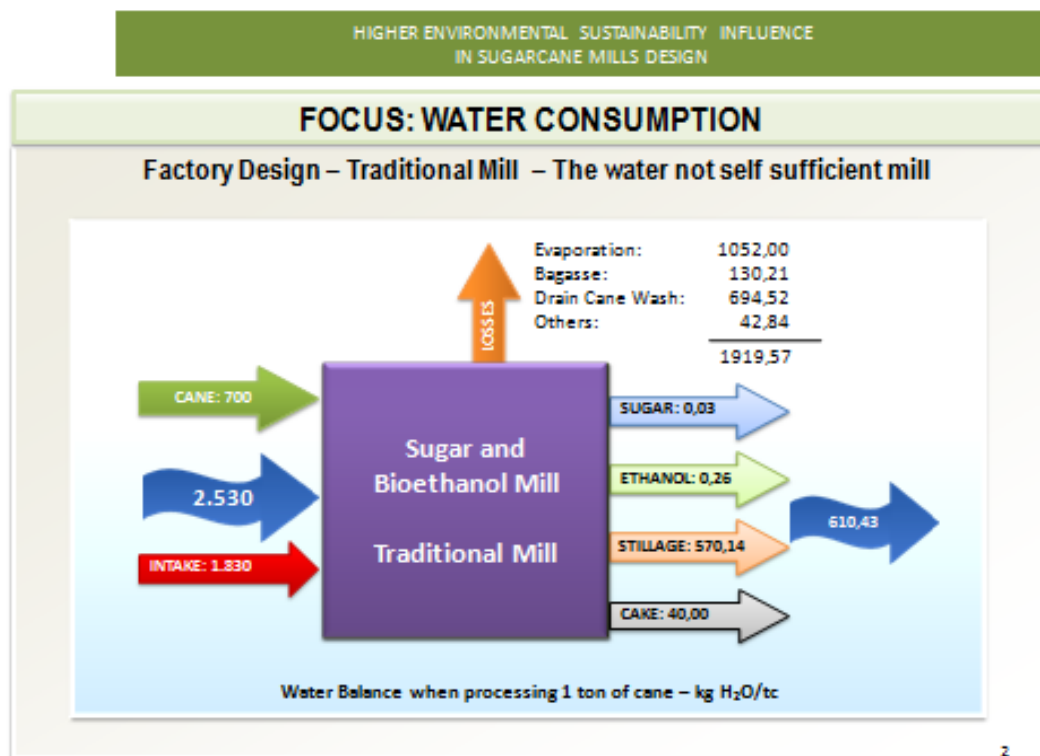
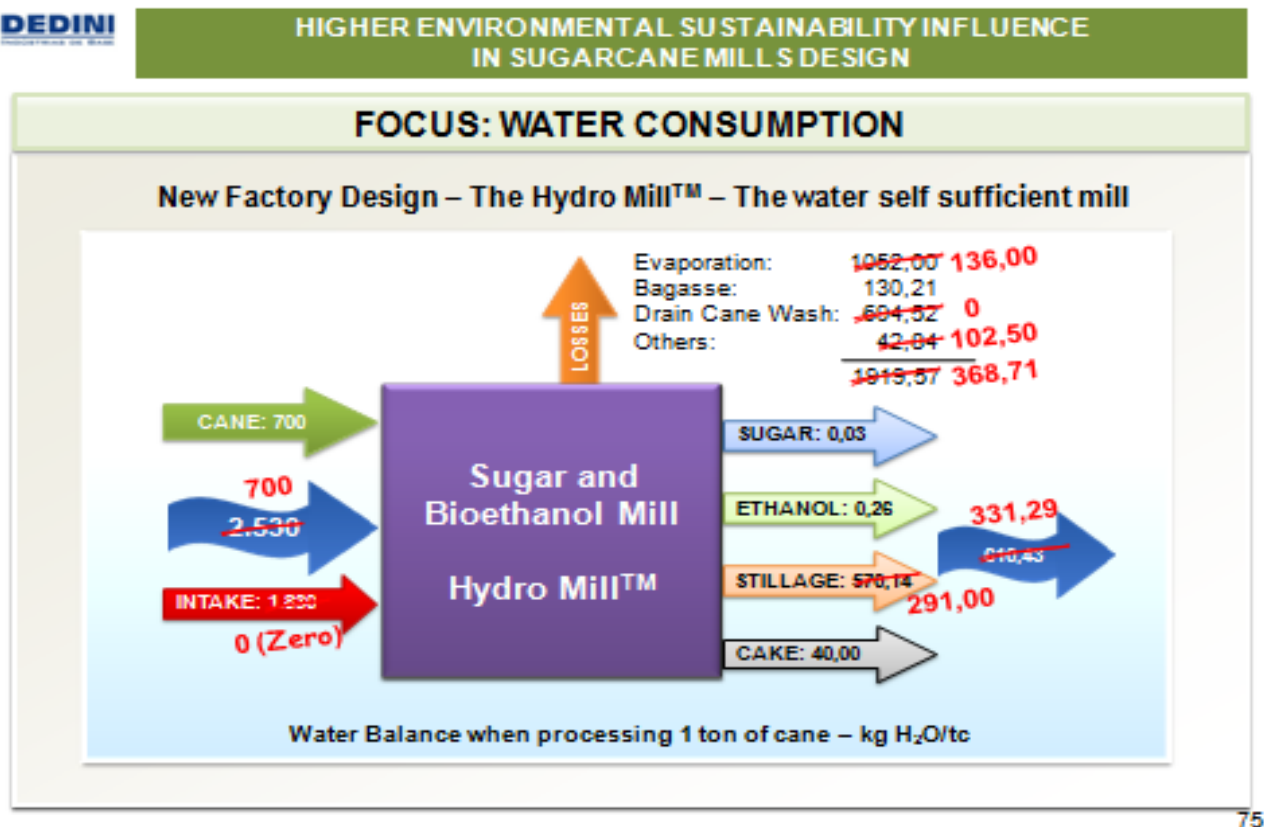


Fig. 1—Water balance in a traditional mill.

Water exits the factory with various products such as finished goods like sugar and ethanol, but also with the filter cake, bagasse (130.21 kg/t cane) and stillage (570.14 kg/t cane). The biggest quantity evaporates during cooling of condensing water (1052.00 kg/t cane). Wet cane washing, where applied, consumes 694.52 kg/t cane. There are other smaller quantities required for floor washing, restrooms, canteens, etc.)

**Self-contained mill**

An important step would be minimising or even bringing the need for in-take water to zero and only utilise the water available with the cane; Measures to be implemented are to replace cane washing with dry cleaning. The water balance for a self-contained mill is shown in Figure 2.



75

Fig. 2—Water balance in a water self-contained mill.

By using vapours from the last effect of the evaporators and the vacuum pans for heating purposes (mixed juice heaters) the quantity of condensing water reduces from 1052.00 kg/t cane to 136 kg/t cane.

Water savings can also be made through improved design of the fermentation process. The alcohol content in the beer can be increased from 9.0 to 12.0 vol. % with newer designs. The process can be operated at lower temperatures (less than 30°C).

Less steam is required at the distillation columns and the stillage quantity reduces from 10.0 kg/L ethanol to 6.0 to 7.0 kg/L ethanol, which is 291.00 kg/t cane instead of 570.14 kg/t cane.

The spent wash, from the bottom of the rectification column, can be used in various sectors of the plant for cleaning equipment with good results.

### Water exporting mill

The final step in water preservation is to move to water generation in the ‘Hydro Mill Plus’ (Figure 3).

The use of process steam and alcohol vapours from the rectification column as heating media in an energy optimised process should be considered. Resulting vapours would be sent to the juice concentrators for fermentation.

Concentrated stillage mixed with filter cake, boiler soot and ash with addition of other nutrients results in an ‘organomineral biofertiliser’ (BIOFOM). It contains 4.66 kg water/t cane.

The result of these measures allows the export of some 290.71 kg water/t cane, which is about one third of the water introduced with the cane.

Utmost extraction of energy contained in the various condensates contributes to the overall energy balance of the factory resulting finally in increased production of exportable electricity.

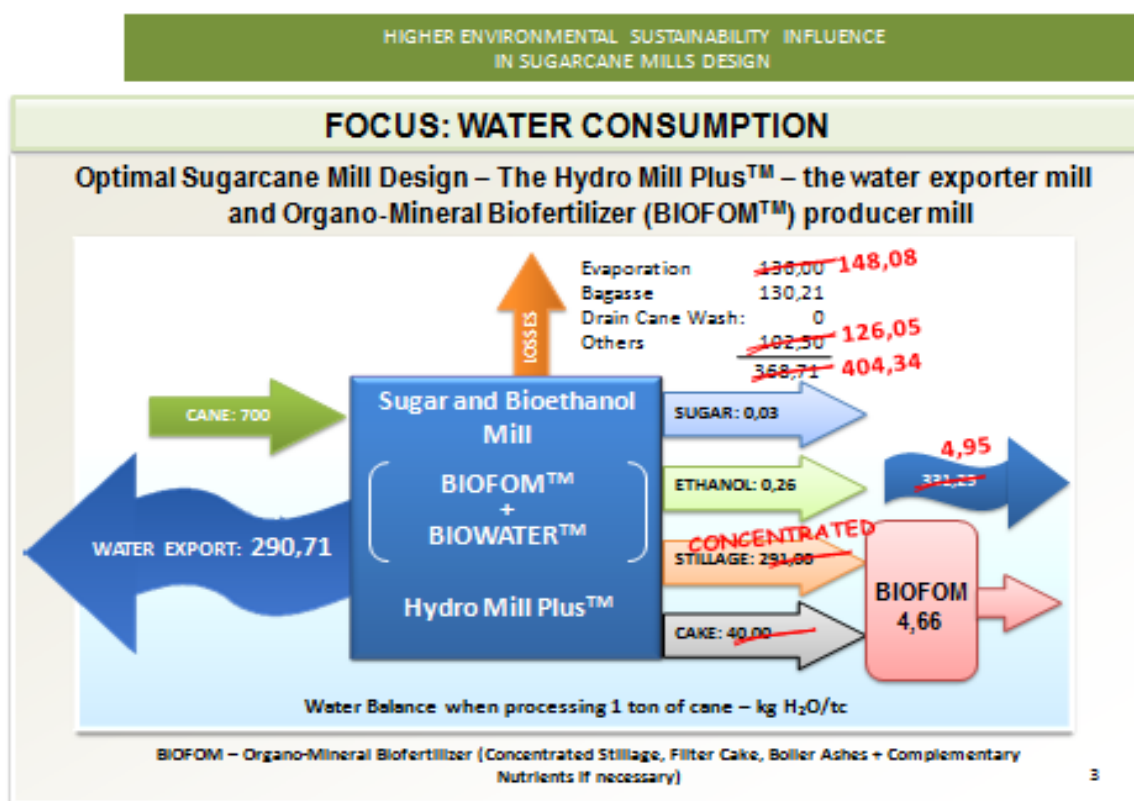


Fig. 3—Water balance in a water exporting mill.

In summary, the following are required:

- Use of condensates as imbibition water;
- In preparation of mixed juice for fermentation, utilisation of energy from cooling the clarified juice (heat exchange), flash vapours and vapour condensates;
- Washing filter cake with condensate;
- Applying multi-effect juice evaporation with vapour bleeding for distillation and heating purposes;
- Exhaust condensate to be returned as feed water to the boilers, minimising heat losses;
- Utilising last vapours for mixed juice heating;
- Depending on the proportion of juice for ethanol and the quantity of molasses, there may be no need for pre-concentration of clarified juice for ethanol;
- Sugar boiling only with vapour;
- Utilising heat exchangers with condensates and /or vapours throughout the process;
- Producing a fermented beer with the highest possible alcohol content;
- Using vapours from juice or stillage evaporation in distillation;
- Concentrating stillage to 60% solids using vapours from juice evaporation and alcohol distillation;
- Drying stillage and mixing it with filter cake and boiler soot and ash to obtain 'organomineral fertiliser (BIOFOM)';
- Heat the beer for distillation with heat exchangers;
- Recovering of all condensates.

It is recognised that reused water will require pre-treatment and increased operating costs to achieve it.

### **Progress and conclusions**

Dedini has taken an important step towards economic, social and environmental sustainability of the Biosugar and Bioethanol plants and, in 2008, has launched self-sufficient water mills and Biowater - water production mills. These plants are self-sufficient in water, and do not demand external supply from water sources. The water in sugarcane alone is sufficient to meet the requirements of the internal processes of the plant.

The further development of this concept is the optimisation of this technology, so that the Biosugar and Bioethanol mill saves more water from sugarcane than it will use in the internal process, and will thus be in a position to export BIOWATER as excess water for industrial use.

## **USINE DE PRODUCTION D'EAU**

Par

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### **MOTS-CLEFS: L'Eau, Production d'Éthanol et de Sucre.**

#### **Résumé**

L'EAU douce est devenue une des plus importantes ressources naturelles dans le monde. Elle est fondamentale pour l'homme, pour leur propre consommation, dans les industries, l'irrigation agricole, la production de l'alimentation et de l'électricité et également dans les activités de loisirs et d'amusement. Pour les industries, la disponibilité de l'eau douce peut représenter un facteur décisif dans le choix de l'emplacement d'une nouvelle entreprise. Dans le cas de la production de sucre et d'éthanol au Brésil, la culture de la canne traditionnelle n'utilise pas d'irrigation, qui est un facteur important du point de vue environnemental, parce qu'elle utilise moins d'eau douce, évite l'entraînement de nutriments, de résidus toxiques agricoles et les pertes de sol. Dans la production de sucre et d'éthanol, conformément à la moyennes de données pour l'état de São Paulo en 2005, la consommation d'eau était 21 m<sup>3</sup> d'eau par tonne de canne (180 litres par litre d'éthanol) et un apport de 1,83 m<sup>3</sup> d'eau par tonne de canne (près de 22 litres par litre d'éthanol). Une demande croissante de la consommation d'eau fraîche et la pénurie de cette ressource à un niveau mondial sont des préoccupations pour plusieurs secteurs de la société. Devenant de plus en plus critiques, ces problèmes exigent des attitudes plus responsables par les entreprises, tout en faisant des efforts pour suivre une politique de développement durable afin de consolider leurs produits et leurs existences.

## PLANTA DE PRODUCCIÓN DE AGUA

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**PALABRAS CLAVE:** Agua,  
Plantas de Azúcar y Etanol, Vinazas.

### Resumen

EL AGUA fresca se está convirtiendo en uno de los recursos naturales más importantes en el mundo. Es fundamental para los seres humanos, para su propio consumo, en industrias, irrigación agrícola, producción de energía eléctrica, y también para actividades de recreación. Para las industrias, la disponibilidad de agua fresca puede representar un factor decisivo en la escogencia de la ubicación de una nueva planta. En el caso de la producción brasilera de azúcar y etanol, el cultivo tradicional no usa irrigación, lo cual es un factor importante desde el punto de vista ambiental debido a que usa menos agua fresca y evita el arrastre de nutrientes y residuos agrícolas tóxicos así como las pérdidas de suelo. En la producción de azúcar y etanol, de acuerdo a datos promedio para el Estado de São Paulo en 2005, el consumo de agua fue de 21 m<sup>3</sup> de agua/tonelada de caña (180 litros por litro de etanol), y un gasto de 1.83 m<sup>3</sup> de agua/tonelada de caña (aproximadamente 22 litros por litro de etanol). La creciente demanda de consumo de agua fresca y la escasez de este recurso a nivel mundial son una preocupación para varios sectores de la sociedad, en la medida que asumen una posición crítica, demandando más actitudes responsables por parte de las compañías siguiendo una política de desarrollo sostenible para consolidar sus empresas y sus productos.