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OUTLOOK 2019

Making Science, Innovation and Research work for the Sustainable Development Goals

EDITED BY

ALLAM AHMED

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ENVIRONMENTAL BENEFITS OF USING SUGARCANE BAGASSE IN BY-PRODUCT DEVELOPMENT: A CASE STUDY ON EID-PARRY (INDIA) LTD (EID-PARRY)

ABSTRACT

PURPOSE

Amalgamating the use of sugarcane bagasse into products is a good alternative for reducing impact on the environment. Several other studies have been carried out that focussed on the use of agro-waste; sugarcane bagasse has been well established as an example of this. From each tonne of sugarcane, the average bagasse produced is 280kg. This bagasse is the raw material for several potentially commercial industries.

DESIGN/METHODOLOGY

The objective of this study is to analyse and encourage the different uses of sugarcane bagasse in the development of by-products, or the utilisation of sugarcane bagasse in the development of pre-existing products. This study tried to discover how sugarcane bagasse is potentially used as a by-product in a leading company, EID-Parry (India) Ltd.

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Sustainable development is development that meets requirements without disturbing the factors of the future environment; it bears in mind social and economic limitations in order to maintain a clear balance between requirements and the environment. Some developments only have one aspect in mind and do not look at the wider impact or futuristic approach of the development and its impact on the environment; this can clearly be seen in terms of the dependence on fossil fuel-based energy sources. This is one of the major challenges in the current scenario. There are many alternatives available to substitute fossil fuel with other sources in the industrial base. There is, therefore, a need for a self-sufficient ecosystem or sustainable development.

FINDINGS

This study examined the various measures taken by EID-Parry (India) Ltd, which uses sugarcane bagasse to generate power to their own unit; this is adequate for operating the co-generation plant for about 200 days.

ORIGINAL/VALUE OF THE PAPER

EID-Parry (India) Ltd is successfully utilising sugarcane residuals into alternative means of usage, and therefore reducing the environmental impact.

Sugarcane is one of the important agricultural crops cultivated in tropical countries. The annual global production of sugarcane is 1.6 billion tonnes. In post-harvest processing, the sugarcane is left in the open retaining many residues, such as sugar bagasse (SB) and sugar leaves (SL). On average, the sugarcane retains 279 million metric tonnes (MMT) of biomass residues (bagasse and leaves) (Chandel et al., 2012). Industries can use the sugarcane residuals as by-products in different stages. This will reduce environmental hazards.

This study aims to discuss the efficiency of SB by the utilisation and development of by-products by EID-Parry (India) Ltd; thereby producing less waste and having a more sustainable development of the ecosystem. The paper focusses on the initiatives taken by the company in terms of the utilisation of SB.

LITERATURE REVIEW

The study conducted by Daissy Lorena Restrepo-Serna et al. (2018) aimed to produce biorefineries from sugarcane bagasse (SB). The study shows that processing agricultural products produces different types of waste. This creates major environmental issues in terms of the disposal of waste materials (Huang et al., 2008). Several studies have discussed possible measures to use this waste in different transformation processes in order to utilise value-added products. It is a challenge for agro-industrial waste to be used as a renewable raw material, especially in terms of commonly used raw materials such as sugarcane (Moncada et al., 2014). SB is a residue that is obtained from sugarcane processing. A total of 280kg of bagasse is generated from 1 tonne of processed sugarcane (Moreira, 2000).

LIMITATIONS/IMPLICATIONS

Industrial effluent management, treatment and disposal are some of the major concerns faced by industries around the world. To reduce the impact of waste disposal on the environment, by-product development is necessary. This study did not use any scientific approach; this is one of the major limitations of this study and further scientific research is needed regarding the industrial requirements.

KEYWORDS

Agro-waste; Sugarcane bagasse; By-products; Environment

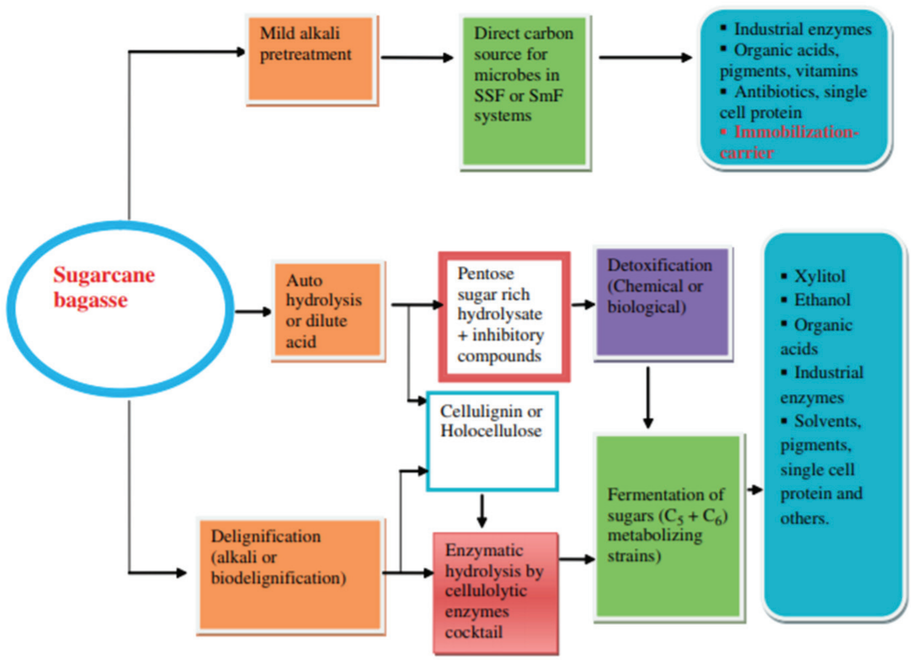

FIGURE 1 **Procedural steps involved in the application of SB for the formation of various industrially important products.**
Source: Chandel et al., 2012

Countries such as Brazil, India, China, Thailand, Pakistan, Mexico, Colombia, Indonesia, Philippines, and the United States are the major producers of sugarcane[1]. Between 2017 and 2018, the world production of sugarcane amounted to 280 million metric tonnes. As the production of sugarcane increases, this will increase the amount of sugarcane residues. SB is a residue that is rich in polysaccharides (widely studied in the production of biofuels (Duque et al., 2015)), and chemicals such as ethanol, xylitol, enzymes, biopolymers, antioxidants, and lactic acid, among others (Mussatto et al., 2013). It also has a high capacity for the generation of energy through the application of the gasification process (Moncada et al., 2014). Therefore, the development of bio-refineries from SB has been analysed in many studies, with a great variety of possibilities for its use.

Pereira et al. (2015) analysed the bondage between properties of green matter, such as the leaves and stems of the sugarcane, by finding uses for SB cellulose fibre at a nanoscale, and its application in different designs. This study evaluated packaging materials using interdisciplinary approaches by applying the results of the research onto selected designs. As a conclusion, they were able to evaluate the impact of packaging material design on the environment; this stimulated the use of the nanocomposite on the bases of the SB as the major raw material. These analyses include the sustainable design of the particles that account for the level of power composition, together with the life cycle of the product. In terms of future studies, more experiments that include and cover more aspects are needed.

[1] http://www.worldatlas.com/articles/top-sugarcane-producing-countries.

The properties of SB and SL on both technological and non-technological applications are discussed. The major aspects that have been explored are lignocellulosic bioconversion, economic utilisation of production of bioethanol and value-added commercial products such as xylitol, speciality enzymes, organic acids, single-cell proteins, etc. At the same time, the economic development of the bio-based products that could potentially be commercially processed is examined. Chandel et al. (2012) stated that SB has been successfully converted into many value-added products; these include ethanol, xylitol, organic acids, industrial enzymes, and other important speciality chemicals. These are summarised in Figure 1 above.

Praveen Kumar et al.'s (2018) study discussed the development of food safe packaging material, mainly trays for fresh fruit and vegetables. This study stated that sugarcane materials are used in packaging materials. These include the residues, such as bagasse, collected after crushing the sugarcane; this is the raw material for the production of this packaging material. This process is followed by milling, forming, and drying, among other procedures. The final product aims to replace plastic and foam products used to pack goods, making it eco-friendly in nature.

FIGURE 2

Fruit Trays

Source: Praveen Kumar et al., 2018

FIGURE 3

Mushroom Trays

Source: Praveen Kumar et al., 2018

FIGURE 4

Egg Trays

Source: Praveen Kumar et al., 2018

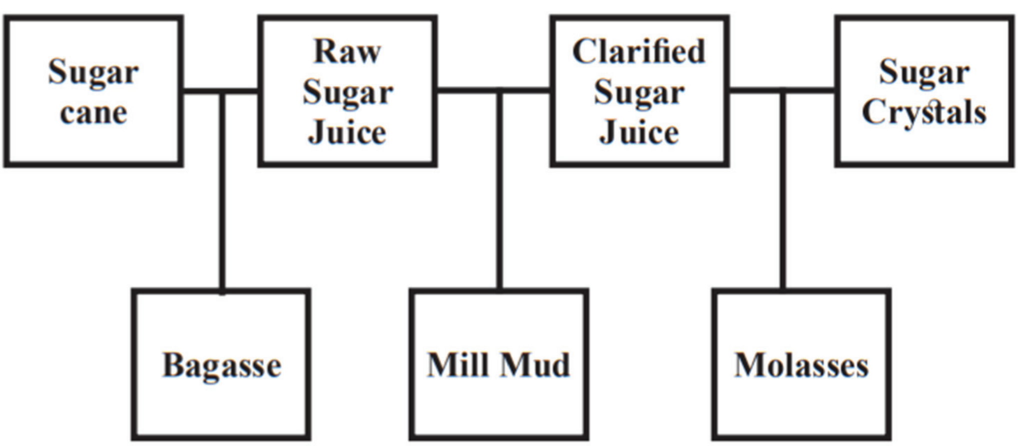

FIGURE 5

Process of Waste Production

Source: Praveen Kumar et al., 2018

With a focus on creating various sizes and shapes according to requirements, these packaging materials are biodegradable, eco-friendly, odourless, unbleached, microwavable, non-toxic, sustainable resources; they can also be frozen. All the packaging materials were tested for their quality and sustainability. This study was successful in the development of an efficient packaging material. Pictures of the packing materials are shown in Figures 2–4 above, while Figure 5 shows the process of waste production.

The study conducted by Poopak and Agamuthu (2011) discussed the reduction of the impact on the environment during the paper production processes used by the Pars Paper Factory, Iran. This was done by evaluating by using the Life Cycle Assessment (LCA) method. This factory produces one metric tonne of paper on a regular basis, contributing towards abiotic depletion, acidification, eutrophication, global warming, ozone layer depletion, human toxicity, fresh water aquatic eco-toxicity, marine aquatic eco-toxicity, terrestrial eco-toxicity and photochemical oxidation. However, using bagasse as an alternative to virgin wood, electricity contributed the lowest impact value because both inputs used renewable sources. This study concluded and demonstrated that using bagasse instead of wood pulp meant that hydro-electricity, as a major source of energy in paper factories, has a high probability of reducing environmental hazards, and thereby its impact on global warming. As a result of using bagasse, the paper was of high quality, with low percentages of environmental hazard.

Poopak and Reza's (2012) study evaluated the impact of the Pars Paper Factory, Iran on the environment. The parameters used to evaluate this were clay, starch, OBA, aluminium sulphate, chlorine, resin, electricity and NaOH; the results obtained were 0.02%, 3%, 0.5%, 3%, 5%, 2%, 0.1%, 0.002% and 25%, respectively.

The three major conclusions were:

1. nuclear energy and hydro-electricity are used as an alternative source of user-friendly energy for paper making in Mazut;
2. more environmentally friendly materials for bleaching should be used rather than chlorine;
3. paper recycling should be utilised instead of Kraft (a type of tree used as a raw material) to reduce the impact of Kraft on abiotic depletion, acidification, Eutrophication, ozone layer depletion, toxicity, photochemical oxidation, and global warming.

HISTORY OF EID-PARRY (INDIA) LTD

EID-Parry (India) Ltd was founded in 1788 and has a rich history. 'Parry' has been a household name for over 225 years. The company holds the prestige of being India's first sugar plant at Nellikuppam in the year 1842, and even today continues to function fully.

The company is listed as being engaged in the business of sugar and nutraceuticals. Dare House is the company's headquarters and is a heritage building; it is situated in Chennai, India. This company is also a part of Murugappa Group, one of India's leading business conglomerates, valued up to INR 300 Billion.

EID-Parry (India) Ltd is the only sugar brand to be conferred with the 'Super Brand' status in India. It is also one of the first to promote the Fertiliser Industry in India: Coromandel International Ltd is a subsidiary of Parrys, founded in 1953.

Parrys is a fully automated standalone unit in Sivaganga, fully functioning from 2009. It is also the first of its kind in India to have zero emissions, zero effluent and generating its own power. In Nutraceuticals, it is one of the world's leading companies in micro algae technology, comprising spirulina and natural beta carotenoids.

EID-PARRY (INDIA) LTD INITIATIVES IN PRODUCING ZERO EFFLUENT AND EMISSIONS USING EFFECTIVE WASTE MANAGEMENT, RECYCLING, REDUCING AND REUSING SUGARCANE WASTE

The company has taken great initiatives towards producing zero effluent and emissions. Of the molasses used in the production processes, around 48,600 tonnes are acquired from their own unit. The bagasse generated from this is adequate to operate the co-generation plant for about 200 days. Extrasensory perception (ESP) (3.0), together with a stack of adequate height, will be provided to a bagasse-fired boiler (45 TPH[2]). A bag filter, together with stack of suitable height, will be provided to the spent wash fired boiler (10 TPH) to control particulate emissions within 50mg/Nm^3.[3] Total water requirements will be increased from 3,157m^3/day to 4,316 m^3/day after expansion. Out of this 4,316m^3/day, the fresh water requirement after expansion will be 3,161m^3/day; this will be taken from the Kali River.

Wastewater generation from the sugar unit will increase from 480m^3/day to 592m^3/day after expansion. Effluent from the Cogen power plant will be increased from 305m^3/day to 407m^3/day after expansion. Therefore, the existing effluent treatment plant (ETP) will be expanded from a hydraulic load of 1,000m^3/day to 1,600m^3/day. Spent wash from the distillery will be concentrated in migration enhanced epitaxy (MEE), and concentrated spent wash will be incinerated in an incineration boiler to achieve zero discharge. Treated effluent will be reused for horticultural purposes, the cooling tower and water for the boiler. An ignition boiler will be run with coal as a supplementary fuel. Fly ash from bagasse will be used as fertiliser on agricultural land. Ash from concentrated spent wash will be given to the group's fertiliser unit. Spent oil will be sold to authorised recyclers/re-processors.

The various measures taken by the company in terms of waste management in handling the molasses, sugarcane bagasse and waste water are as follows:.

- Consumed wash generation from molasses does not exceed 8Kl/Kl of alcohol produced (i.e., 720m^3/day). The spent wash from the molasses-based distillery is concentrated in MEE; concentrated spent wash will be burned in the boiler to achieve zero discharge. Condensate water and treated spent will be reused as a dilution water for fermentation, cooling tower and the boiler for the production of steam.

[2] Tonnes per hour

[3] http://www.eidparry.com/about-us/company-profile/

- Wastewater generation from the sugar unit will not exceed 100 litres per tonne of cane crushed (i.e., 600m^3/day). Effluent from the sugar unit will be treated in the ETP. The water quality of treated effluent will be monitored regularly; however, no wastewater/treated effluent will be discharged into rivers/natural streams. Domestic effluent will be treated in the treatment plant.
- Process effluent/any wastewater will not be allowed to mix with storm water. The storm water drain will be passed through a guard pond.
- As proposed, no effluent from sugar, distillery or co-generation power plant will be discharged outside the premises, and a zero effluent discharge concept will be followed.
- Bagasse storage will be achieved in such a way that it does not become airborne or fly around due to wind. Fly ash will be stored separately as per Central Pollution Control Board (CPCB) guidelines so that it does not adversely affect the air quality, becoming air borne by wind or water regime during the rainy season by mixing with the storm water. Direct exposure of workers to fly ash and dust should be avoided[4].

CONCLUSIONS

To conclude this study, sugarcane bagasse can be used for several environmentally friendly methods. Appropriate initiatives result in a positive impact in the treatment of waste management. The sugarcane bagasse can be used in the development of by-products or utilised in the further development of products; the following are a few examples:

- development of chemicals such as bioethanol, xylitol, enzymes, biopolymers, antioxidants, lactic acid, organic acids and industrial enzymes;
- development of fertiliser by burning the SB and using the ash as fertiliser in order to replenish depleted nutrients;
- development of fermented beverages with the use of SB as one of the main raw ingredients;
- development of bio-refineries with the use of SB, among other ingredients;
- development of paper, replacing wood pulp with SB pulp.

With the advent of rapid industrialisation, it is the responsibility of the industrial units to use their waste by-products smartly. This will result in reducing the cost of the disposal of industrial effluents, and in reducing the negative impact on the environment. The measures taken by EID-Parry (India) Ltd set an example as to how industrial units can productively handle their waste by-products and make their potential a possibility.

[4] http://www.eidparry.com/wp-content/themes/eid/pdf/environmentalclearance-04feb2015.pdf

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