Version BLUE

1. INTRODUCTION

The Brazilian government announced in September 2015 an ambitious reduction of 37% of greenhouse gases emissions by 2025 (VALOR ECONÔMICO, 2015a). This important announcement will be definitely a driver for the industrial and transport activities in Brazil during the next years. The airways sector, however, are going in the opposite direction of this announcement: it is expected an increase of 42.5% of jet fuel requirements to fulfill the airways activities, reaching 6.3 billion liter per year by 2024 (Boeing et al., 2013).

Currently, most of the Brazilian jet fuel comes from non-renewable sources (oil) and is either imported or internally produced by Petrobras. The National Oil Agency (ANP) announced that the oil production estimate in Brazil is going to decrease from 4.5 to 4.0 million of barrels per day until 2025 (VALOR ECONÔMICO, 2015b). A predictable fuel shortage shall be faced by the airway sector within the next years.

A possible solution for this problem is the use of products from renewable sources, such as biomass. Brazil is internationally recognized for the use of biomass for energy purposes, which represents around 30% of the energy matrix (BOEING et al, 2013). Considering this enormous amount of biomass available in Brazil, the sugarcane is a good candidate to start a bio jet fuel industry in this country, because Brazil is the world largest producer of sugarcane and it is an established crop. The sugarcane feedstock annual production is approximated 620 million tons in 9.2 million hectares, which represents 1% of Brazil territory (UNICA, 2012).

Furthermore, another reason to consider sugarcane biomass for bio jet fuel application is the use of its agriculture residues for second-generation bioethanol production has become an industrial reality in Brazil (UNICA, 2014). The sugarcane agricultural residues are bagasse and straw, which are produced with no feed uses and with a high energetic potential. The bagasse is mostly used to generate steam and electricity to the industry (Dias et al., 2011). While, the straw appears as an important and unused source of biomass due to the legislation changes that will forbid sugarcane straw field burns by 2017 due to the Federal Act (Decreto Nº 2.661/1998) and São Paulo state law nº 11.241/2002 were approved, in 1998 and 2002 respectively. Thus, it is expected a considerable amount of sugarcane straw available by 2017, which can be used to produce second-generation bioethanol.

In face of these facts, the biorefinery concept in the sugarcane mills will be essential to keep the production of ethanol and fulfill the future demand for oil products such as jet fuel. Therefore, this study aimed to evaluate technically and economically the biojet fuel production from both first and second-generation sugarcane ethanol, using ATJ (alcohol to jet fuel) technology, and with a production of approximately 30 thousand tons/year of biojet fuel.

Version ORANGE

1. INTRODUCTION

The Brazilian government announced in September 2015 an ambitious reduction of 37% in greenhouse gas (GHG) emissions by 2025 (VALOR ECONÔMICO, 2015a). This announcement certainly poses a challenge to the aviation industry, whose jet fuel demand is expected to increase by 42.5%, reaching 6.3 billion liters per year by 2024 (BOEING et al., 2013). Currently, most of the jet fuel consumed in Brazil comes from non-renewable sources (oil) and is either imported or internally produced by the state-owned company Petrobras. To make things worse, the Brazilian oil regulatory agency (ANP) estimates that oil production in Brazil will decrease from 4.5 to 4.0 million barrels a day through 2025 (VALOR ECONÔMICO, 2015b). This significant reduction over the same period will also have to be accommodated by the aviation industry.

In face of this scenario, airline companies have created a market pull for technologies able to convert biomass into jet fuel. Not surprisingly, these companies see Brazil as a strategic partner in this endeavor. Brazil is internationally recognized for the use of biomass - especially sugarcane - for energy purposes. Biomass has a share of about 30% of the energy matrix (BOEING et al., 2013). The sugarcane industry with its established supply chain is certainly a good candidate to provide feedstock for the emerging bio-jet fuel industry.

The annual sugarcane production is approximately 620 million tons, distributed over 9.2 million hectares, which represents 1% of the Brazilian territory (UNICA, 2012). This feedstock has been used for the production of sugar, ethanol, and electricity. The former two products are produced from sucrose, and the latter is obtained by burning the bagasse from the sugarcane plant. Whereas there is a market in place for bagasse, especially for cogeneration, another important (in mass) by-product of this industry, the sugarcane straw, has not yet found its market value. Prompted by changes in legislation, sugarcane producers have been gradually stopping the burn of straw in the field. In this context, a question to be addressed is whether this still untapped source of biomass is an economical feedstock for jet fuel production.

To answer this question, a techno-economic analysis was conducted considering as a design base case the biochemical conversion of straw to ethanol followed by catalytic conversion to jet fuel (the alcohol to jet fuel technology – ATJ). Both greenfield and retrofit design options were considered and confronted against the lower-risk design option of supplying the ATJ plant with first-generation ethanol produced from sucrose.