BASIC DESIGN OF A FLUIDIZED BED GASIFIER FOR RICE HUSK ON A PILOT SCALE

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***Abstract*— With the purpose of contributing to the energetic valuation of the solid wastes generated by the Colombian agricultural industry, a practical methodology for the design of a fluidized bed gasifier for rice husk on pilot scale was developed. The gasifier equipment, made up of a reaction chamber of 0.3 m of internal diameter and 3 m of overall height, was designed from theoretical and experimental information available in the literature and from the past experiences of the research group. A design procedure was elaborated for each one of the seven parts or subsystems in which the gasifier equipment was divided, intending to produce an energetic gas with approximately 70 kW of useful energetic power. Experimental tests performed with a gasifier fabricated according to the designs showed that the developed procedure was adequate, with a maximum deviation close to 50% for the operational performance variables. Therefore, the basic model developed in this work shows that it is helpful for preliminary prediction of the equivalence ratio, low heating value, volumetric yield, gas power and cold efficiency obtained in experimental atmospheric bubbling fluidized bed biomass gasification tests.**

***Keywords*— Rice Husk, Gasification, Fluidized Bed, Biomass.**

I. INTRODUCTION

Currently, most of the electrical or thermal energy consumed in the world is generated through the use of non-renewable energetic sources that, in the future, will increase strongly their price due to their potential shortage in the market. On the other hand, there are the renewable energetic sources that can in the long term be used permanently without any exhaustion threat. This is the case of the vegetal-type biomass, which is currently being considered a promising energy source.

The world's existing preoccupation about the contamination of the atmosphere with harmful gases for the stability of the planet's weather is combined with the necessity to valorize agricultural wastes like rice husk, cane bagasse and sawdust, among others.

In Colombia, around 2.5 million tons of paddy rice are produced per year whose processing generates approximately 500,000 tons of rice husk. This waste is currently used for many purposes such as floor covering in stables, moisture retention in crops, and drying of grains in furnaces. Although there are multiples uses for this waste, a great part of the resource remains unused, becoming an environmental problem of solid wastes disposal.

In recent years, there has been a lot of work in rice husk combustion technologies, however, the controlled production of energetic gas obtained through gasification processes has attracted a greater interest. In this process, the rice husk is thermally decomposed in an atmosphere with oxygen deficiency. The fuel gas obtained can be used in many applications such as feeding furnaces or boilers and fueling internal combustion engines for electrical power generation.

Conscious of the importance of the application of this clean technology for the country, the Environmental Research Group (GIA) of the Pontificia Bolivariana University (UPB), with financial support from SENA - COLCIENCIAS (Contract Nº 577-2002) and the participation of PREMAC S.A., coordinated the design, fabrication and the operational evaluation of a fluidized bed gasifier for rice husk on a pilot scale. This article shows the main procedures followed in the gasifier design process.

II. METHODOLOGY

The gasifier design was made according to information available in the literature with innovative reforms implemented by the research group. The calculation model was developed separately for each one of the seven parts or subsystems in which the gasifier equipment was divided. Also, the preliminary operating conditions were included (fluidization velocity and equivalence ratio), necessary for the energetic gas production on pilot scale.

A. Reactor Subsystem

It is made up of the reaction chamber (three cylindrical modules arranged vertically), external heat insulation, an air distribution plate and a plenum.

For the design calculations, the physical properties of the rice husk and the inert material (common sand) composing the bed were determined. The values of these properties for both materials appear in Table 1 (Martínez, 2005).