

## ENCIT-2018 ANALYSIS OF THE INFLUENCE OF A GAS RESERVOIR (LUNG) INTRODUCED INTO A BIOMASS GASIFIER

**Francisco Everton Tavares de Luna**

**Emerson Freitas Jaguaribe**

Federal University of Paraíba, Department of Mechanical Engineering, João Pessoa - PB, Brazil  
[emerson@ct.ufpb.br](mailto:emerson@ct.ufpb.br)

**Adriano Sitônio Rumão**

Federal University of Paraíba, Department of Mechanical Engineering, João Pessoa - PB, Brazil  
[adrianositonio@yahoo.com.br](mailto:adrianositonio@yahoo.com.br)

**Vinicius Mafra Melo**

Federal University of Paraíba, Department of Mechanical Engineering, João Pessoa - PB, Brazil  
[vmafram@hotmail.com](mailto:vmafram@hotmail.com)

**Vicente de Vasconcelos Claudino Filho**

Federal University of Paraíba, Department of Mechanical Engineering, João Pessoa - PB, Brazil  
[vicentevclaudinofilho@gmail.com](mailto:vicentevclaudinofilho@gmail.com)

**Abstract.** *The biomass gasification has been excelled in the last years as an most promising alternative in the clean energy generation, which transform the biomass in a low calorific value fuel, capable of feeding intern combustion engines for power generation. Has been more investment on researching in gasification, due to improve the process and make it more efficient. This work has as goal investigate the energetic influence of gas reservoir (lung), in the generation system from the biomass gasification, formed by the gasifier and the generator set. Had been verify in this work that the gas reservoir exert the same functions of the compressed air, used in compressors. Among those functions, can be excelled that the lung provides the decrease of engine start time, and prevented that the water it was dragged to the fabric filter, avoiding the interruption of the process.*

**Keywords:** *Gasifier, Lung, Biomass, Gasification*

### 1. INTRODUCTION

It is known that every process, even a simple food transportation, or something more complex, like automobile making, take losses. Those losses make the process less efficient, and this brings an increase in the manufacturing prices, leading to a higher price to the final customer. One researching made by Fuentes (2015) reveals that Brazil is the 6<sup>th</sup> country with the most expansive electricity energy in the world, which refers to an inefficiency in its process of generation and distribution. Another factor that also has favored to the increase in the cost of the electricity energy is seasonality. This aspect affects straight the hydroelectric plants, the main source of electricity energy in the country, forcing the activation of the thermoelectric plants, which has a higher cost of generation. To improve the process of electricity energy generation in the country and reduce the dependence of the hydroelectric, searching in alternatives energetics that be efficient, economically and environmental. Among those alternatives, the biomass gasification excels, which is a process that transform organic material in a fuel gas.

One of the gasification problem is the suction of the water from the reservoir to the fabric filter, which causes interruptions in the process and demands major maintenance of the equipment. Another factor that also can be considered is the long time that the engine takes to stabilize in the moment of start. To become the gasification process more efficient, this work has as goal evaluate the use of a gas reservoir in a gasification system, verifying its influence on the process efficiency.

### 2. METHODOLOGY

This work it was made in the Laboratório de Inovação (LI), in the Universidade Federal da Paraíba (UFPB), using as tools for the tests the Indian gasifier, see Figure 1, and the generator set.

The previously works made in this gasifier had shown operational problems related to the suction of the water by the engine, which entailed in interruption of the process and in a high equipment maintenance. Knowing this, Bezerra (2016) introduced into the gasifier a gas reservoir, see Figure 2, which one had the main function gathering this water. However, to verify more detailed the influence of this reservoir in the system, it was needed to made new tests.

## 2.1 The Gasifier Used

The gasifier used in this work it was the fixed bed type, co-current, “open top”, which was imported from India, from Indian Of Science/Combustion Gas Propulsion Laboratory (Figure 1). This gasifier it was developed to feed a Dual engine type, with a maximum generation capacity of 20 kWe. However, posterior works had proven that it use in Otto cycle engines (RUMÃO, 2013, e BEZERRA, 2016) had obtain bigger potencies that specified by the manufacturer. Rumão (2013), obtained in his power tests 26 kWe, requiring less energy compared to the original model, while Bezerra (2016), had reach 29 kWe.



Figure 1. The Gasifier Used In This Work.

## 2.2 Instalation Of The Gas Reservoir

The reservoir used in this paper it was first introduced into gasifier by Bezerra (2016), in order to avoid that the water it was dragged to the fabric filter, what prejudice the engine works. However, it could realize that beyond solve the problem of the water in the fabric filter, the lung works as a compressed air reservoir, which in the moment of engine start stabilizes the pressure faster.

The first recipient used as lung it was made by PVC. This lung was connected to a PVC pipe between the cooler and the fabric filter, see Figure 2. However, due the high suction of the engine, it was necessary to change this reservoir for a more resistant, made by steel 1020.



Figure 2. The Gas Reservoir

## 2.6 The Tests

The biomass used in the tests it was obtain from woods rejects from UFPB (chairs, tables, door and slats) and pallets. To assure a better packing of the biomass in the reactor and this way a more uniform burning, those woods it was cut in tablets, in a standard size, established by Rumão (2013), in the measure of 60 x 25 x 25 mm.

To verify the influence of the gas reservoir, it was gathered data of pressure and temperature in many points of the system, as the composition of the gas, biomass consumption and the time that the engine took to stabilize in each power. It was also defined the angle of ignition that it will be use in each power to the data gathering. Those angles it was chosen taking as base the work of Melo (2018), shown in the Table 1.

Table 1: Better angle of ignition for each power.

Power	Angle
8,4	9°
13	16°
18	12°
23	16°
26	12
29	12
34	9

## 3. PRELIMINARY RESULTS

The Figure 3 shows the values of the temperatures gathered from each line of the engine intake.

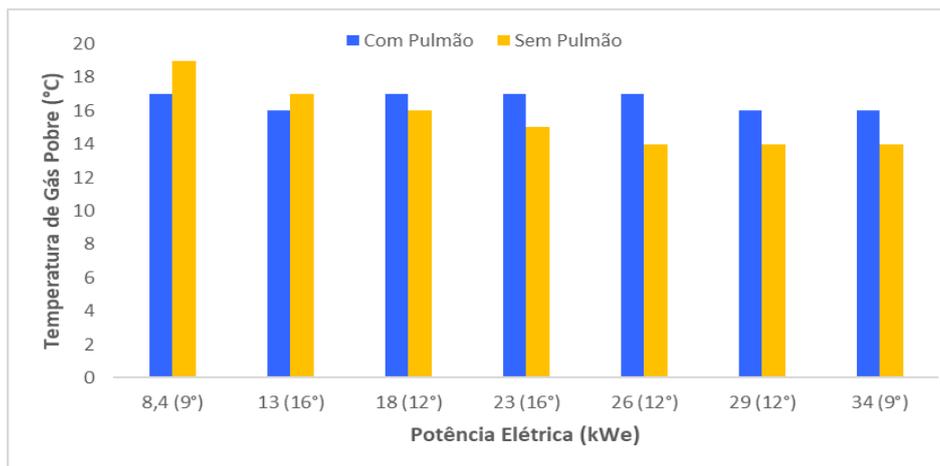


Figure 3. Comparison of the temperatures of the poor gas in intake, from the system with lung and without lung.

As can be observed, only in the power of 8.4 kWe and 13 kWe, the values of the temperatures of the system, without lung it was higher to the system with lung. This occurs because in the moment of the test start without the lung the temperature of the water in the chiller is still in 9 °C, while with lung the water is in the minimum temperature of 5 °C.

The pressure measurement showed that the lung generates a cargo loss near  $0.3 \times 10^{-2}$  bar.

To verify the gain that the gas reservoir brings to the gasifier generator set system, it was measured the needed time to start the engine, as the time to add cargo to the system, and give the power increase. To this time it was named "time response". The obtained data are shown in the Table 2.

Engine's response time (min)		
Process	With Lung	Without Lung
Engine's Start	7:43	14:36
Add cargo to the engine	10:41	9:30
(8.4 – 13) kWe	2:16	2:29
(13 – 18) kWe	2:00	1:49
(18 – 23) kWe	1:53	2:15
(23 – 26) kWe	3:32	2:29
(26 – 29) kWe	0:35	0:21
(29 – 35) kWe	1:48	1:12

Table 2. Engine's response time.

#### 4. CONCLUSIONS

Throughout the results obtained in each test, showed in the previous topic, could take some conclusions:

- To the system without lung, the temperature of the intake gas stood below 20 °C, having little range in its process. The system without lung shown lower values compared to the previous system, shown this way that the lung offers a little increase in the gas temperature, due the recipient is not completely thermally insulated. Besides that, the lung generates a little cargo loss in the system.
- About the response time, the lung influences the system only in the moment of the engine start. Without the lung the engine took the double of the time to start.

The use of the lung eliminates the risk of the water be dragged to the fabric filter, what could occur the stop of the engine and an inefficiency in the process. Can be realize the great importance that this device be linked to the system, allowing the engine start faster and eliminating the risk of the water enters in the fabric filter.

## REFERENCES

Bezerra, A. F., 2016, “Aprimoramento da Eficiência de um sistema de Geração de Energia Elétrica por Grupo Gerador Alimentado com Gás Pobre”, Universidade Federal da Paraíba, Tese (Doutorado), Programa de Pós-Graduação em Engenharia Mecânica, Paraíba.

Rumão, A. S., “Geração de Potência e Energia Elétrica a partir da Gaseificação de Rejeitos de Biomassa”. Tese de doutorado apresentada no Programa de Pós-Graduação em Engenharia Mecânica da UFPB, em março de 2013

Melo, V. M., 2018. “Determinação da capacidade limite superior de geração de energia de um sistema formado por um gaseificador de biomassa de 80 kWt e um grupo gerador”. Universidade Federal da Paraíba, Dissertação (Mestrado), Programa de Pós-Graduação em Engenharia Mecânica, Paraíba

Fuentes, A., 2015. “Impávido Colosso – Gráficos, estatísticas e curiosidades nada lisonjeiras sobre o Brasil”. Revista Veja. 21 Apr. 2018 <<https://veja.abril.com.br/blog/impavido-colosso/brasil-piora-em-ranking-e-passa-a-ser-o-6-com-a-energia-mais-cara-do-mundo/>>.