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REPLACEMENT OF ELECTRIC POWER BY NATURAL GAS IN THE MANUFACTURE OF RIGID PIPES

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ABSTRACT

This paper presents a study of how the replacement of electric energy in a process of curing and post curing of epoxy rigid pipes can be replaced by burning natural gas. It is shown that by performing this substitution, through conversion of electric-powered appliances to natural gas, brings a reduction of almost 30% of financial economics.

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Paper

1. INTRODUCTION

Faced with the demand for technical support identified by the Gas Company of Santa Catarina - SCGÁS - for the appropriate service to its customers, was structured Management Natural Gas Technology (GETEC), to promote solutions that bring greater feasibility of using this fuel. Among the main activities developed by the management are technical support, research and technological development, and dissemination of knowledge about the applications of natural gas. Among the lines of action adopted by SCGÁS, for the diversification of natural gas, is replacing the electrotherm. The electrotherm can be defined as the use of electricity to produce heat. This is a front for work that has been successful even in small applications such as textile polymerizer's greenhouses, paint drying ovens and even tanks for metals phosphating. This paper presents an interesting application of natural gas, as a substitute for electricity, in the manufacture of rigid tubes of epoxy resin reinforced with fiberglass and catalyzed with a curing agent based on aromatic amine. These tubes have important applications in the oil industry, and its high-resistance is obtained with the curing and post curing with special resins.

2. PRODUCTION PROCESS

The tubes are manufactured by continuous winding process where you put the liner (pipe) in a mandrel that performs rotation movements. The continuous winding process is the most traditional and reliable method available for making cylindrical tubes and similar equipment. Widely used around the world, the process provides a high level of automation and control with high productivity and economy.

The continuous winding consists of applying the raw materials (resin + fiberglass) cast on a rotating on the tube in order to build step by step the layers forming the wall of the product. In a way programmed and controlled, each material is deposited on the mold in the amount, proportion and manner prescribed in the project in order to give the tube the physical characteristics expected. Finally this tube is then sent to aromatic amine-based curing, post-cure and then to the finish.

3. METHODOLOGY

Through a case study was conducted an evaluation of the process and the original machinery used. Figures 1 and 2 show the hothouses of cure and post cure that operated by electricity.

In Figure 1, we can observe the rising of the tube on the mandrel to the curing oven via an overhead crane. The hothouses consist of “boxes” in which longitudinal tubes are coupled to the curing process heating.

Figure 1: Electric hothouses of cure and post-cure – material's loading

With the tube already placed in the oven, you have the beginning of the healing process of the tube, which rotates as it is heated by electric resistances located in the walls of the oven, as shown in Figure 2.

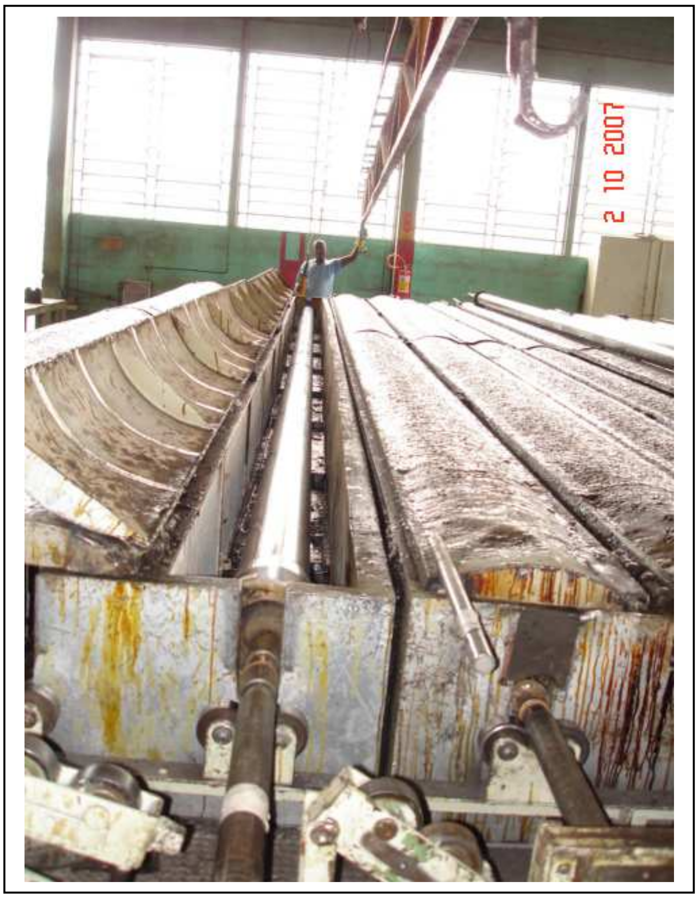

Figure 2: Electric hothouses of cure and post-cure – mandrel placed

By obtaining data in the field (electric power, heating efficiency, load factor, operating systems and average cost of energy), tables were prepared that briefly express the monthly cost of electricity for the machinery of hothouses of cure and post cure . These tables are identified as Table 1 for the curing and Table 2 for hothouse of post-cure.

Power Consumption Estimates (Cure's Hothouse)	
Electric Power [kW]	298
Heating Efficiency	0,80
Load Factor	80%
Operation Regime [hours/day]	24
Operation Regime [days/month]	26
Electricity Consumption [kWh/month]	148.512
Thermal Energy Transferred [kW]	190,40
Average Coast of Electric Energy [R$/kWh]	0,19427
Monthly Coast [R$/month]	**28.852**

Table 1: Electricity consumption of cure hothouse

Power Consumption Estimates (Post-Cure's Hothouse)	
Electric Power [kW]	80
Heating Efficiency	0,80
Load Factor	80%
Operation Regime [hours/day]	24
Operation Regime [days/month]	26
Electricity Consumption [kWh/month]	39.936
Thermal Energy Transferred [kW]	51,20
Average Coast of Electric Energy [R$/kWh]	0,19427
Monthly Coast [R$/month]	**7.759**

Table 2: Electricity consumption of post-cure hothouse

From the operational characteristics of these devices some economic calculations and simulations of technical feasibility were developed, which resulted in a conceptual design of a new stove, produced and operated the equivalent natural gas. Table 3 shows the equivalent consumption of natural gas.

Consumption Equivalent of NG (Estimated)	
Thermal Power [kcal/hour]	207.739
Heating Efficiency	0,60
Lower Heating Value (LHV) NG [kcal/m^3]	8.610
NG Consumption [m^3/hour]	40
Operating Regime [hour/day]	24
Operating Regime [days/month]	26
Daily Consumption – NG [m^3]	825
Consumption [m^3/month]	**25.093**

Table 3: Natural gas equivalent in the hothouses

Figures 3 and 4 illustrate the prototype that was developed and is already in operation. Figure 3 shows the stove curing and post-curing already adapted to run on natural gas, without charge, where the holes can be observed for the injection of hot air, allowing the pipes to be cured by heating. This hot air is produced by burning natural gas in a chamber, located at the bottom of the new designed stove, which also serves to mix a certain amount of dilution air.

The process of making the tube follows the same principle of equipment powered by electricity that is with the help of crane. These new devices have "boxes" of similar dimensions to the old.

Figure 3: Hothouses of cure and post-cure by natural gas developed – without load

Figure 4 shows in more detail the engine that keeps the mandrel turning at a specified time prior to the curing process and post-cure to take effect. This time is automatically timed, from the activation of the hothouse.

This whole process of replacement of equipment brought to the company increased flexibility and productivity, due to a match and achievement of operating systems more quickly. Besides the savings generated, the final product after the mandatory tests, proved to be of better quality when produced using natural gas instead of electricity.

Figure 4: Hothouses of cure and post-cure by natural gas developed – in operation

Seeking to further enhance the relationship with industrial customers already conquered, rewarding those who are deserving of special treatment, the SCGÁS developed the Fidelity Plan, an instrument of compromise between the company and its customers. The Fidelity Plan contemplates a SCGÁS loyalty with awards for the good payers, the industrial customers with the optimized schedule of consumption and that only use natural gas in their processes of heating.

Tables 4 and 5 show the values of annual natural gas consumption and its energy cost of operating of the new equipment the company where this study was done. We applied the current rates of natural gas charged by SCGÁS both with and without the loyalty Fidelity Plan. In the end it has the highest percentage of savings obtained in this case study, with a value of 33%.

Economy	
NG Annual Consumption [m³]	301.112
Average Rate [R$/m³]	1,13045
Annual Cost Operation - NG [R$]	340.392
Annual Cost Operation -Electricity [R$]	439.327
NG Economy [R$/year]	**98.935**
Percentage of Savings	**22,5%**

Table 4: Final Economy

Economy	
NG Annual Consumption [m3]	301.112
Average Rate – NG with FP of 5% [R$/m3]	0,97896
Annual Cost Operation - NG [R$/year]	294.776
Annual Cost Operation -Electricity [R$/year]	439.327
NG Economy [R$/year]	**144.551**
Percentage of Savings	**33%**

Table 5: Final economy with Fidelity Plan

4. RESULTS AND CONCLUSIONS

In this study we evaluated the economic feasibility for substituting electricity for natural gas to attend the greenhouses of healing and post cure in the manufacture of rigid tubes of epoxy resin.

The monthly operational cost of the company with energy input was reduced by 33% with the adoption of new equipment designed to use natural gas. Besides it was observed by those responsible for the company, where this solution has been deployed, there were improvements of operational flexibility, productivity and quality of the final product.

As a final consideration, we register the perspective of increased electricity costs next year and also the increased availability of natural gas from the exploration of new reserves announced in Brazil.

In terms of rational use of energy, the application of electricity to electrotherm is always discouraged when considering the entire chain of generation, transmission, distribution and final use. In this case, natural gas presents itself as a more efficient alternative, which is validated in small industrial applications as we demonstrated in this work.

REFERENCES

1. Nunes, L. R., Rodolfo Jr, A., Ormanji, W., Hage Jr, E., Agnelli, J. A. M., Pessan, L. A. (2002). Tecnologia do PVC, 2ª edição revista e ampliada.
2. Costa, V. M., Gonçalves, R. A. B., Coelho, R. D. (2003). Processos e Fabricação de Tubos e Conexões de PVC, XXXII Congresso Brasileiro de Engenharia Agrícola.

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