

Energy Optimization of Mechatronic Systems
Energy efficiency assessment and optimization of
a flow / level control system

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Introduction

Flow and level control are very common operations in industrial processes, especially in the chemical, petrochemical and agro-food industries. The objective of this project for the students is to get familiarized with the different functional and physical architectures of these regulations systems as well as comparing, at least, two possible integrations of such systems. The choice and sizing of components (pump, motor, valves, piping, etc.) will also be discussed.

Knowledge and skills to develop

The knowledge and skills that will be developed during this project are:

1. Classical architectures of flow / level control circuits
2. Typical elements used in these circuits and their characteristics
3. The tariff structures proposed in France for electricity
4. Approach and formulas for estimating consumption and the monthly/annual energy costs of production systems
5. Formulas for evaluating the profitability of energy efficiency improvement projects

The skills that will be developed during this project are:

1. The energy assessment of a pumping and flow / level control system
2. The use of electrical power measurement instruments and evaluation of the quality of the electricity network
3. The optimization of the tariff and the operating mode of a production system
4. The estimation of the Total Cost of Ownership
5. The selection of the optimal solution and evaluation of projects related to energy efficiency
6. The presentation of an expertise work on the energy performance of production systems.

Work to be done

Pignat bench for level/flow control will be studied. In this work, you will identify the different components of the model and reconstruct the physical architecture of the system as well as the operating modes, estimate the energy consumption of the system according to the different modes, choose the most appropriate tariff proposed by the electricity providers and present the results. These results will be presented on slides with annexes.

Tasks to perform on the Pignat system are:

- From the documentation provided, identify the different components of the control system as well as the physical architecture of the system.
- Identify the different operating modes of the system

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- From the documentation on the machine and the nameplates of the elements, find the technical documentation of the main elements of the energy consuming system
- Considering a system operating at 20%, 50% and then 80% of its nominal load, estimate the power ratings (hydraulic, electrical and possibly pneumatic and thermal) of the system in both operating modes

Considering a company in which five production lines with powers 20 times larger than the studied system, operating on average 80% of their nominal loads and adopting a working regime from 8am to 7pm, 5 days / week:

- Estimate the energy consumption of the company (related to the production) for both modes of operation

Considering that among the two physical architectures studied, it is the least energy efficient installed:

- Choose the most suitable rate from the rates provided by the incumbent operator
- Would it be profitable to make a retro fit knowing that it would cost nearly 20k € per line?
- What would be the payback and return on the investment over 5, respectively 10 years?
- Is the chosen tariff still the most appropriate?
- Do you have any other recommendations to optimize the energy consumption and the cost of the energy for the company?
- Present the results using slides + paper annexes

Good luck