**Universitat Rovira i Virgili**

**Escola Tècnica Superior d'Enginyeria Química**

**Berry Global**

# Implementation of predictive maintenance 4.0 on vibration analysis


**Master thesis presented by**
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to obtain the Master's degree in Chemical Engineering from the Universitat Rovira i Virgili

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Tarragona, April 2022

## SUMMARY

In the present thesis, it has been studied the possibility to implement a Predictive Maintenance 4.0 on Vibration Analysis in Berry Global company, with the purpose of improving the manufacturing process by detecting non-previewed breakdowns, reducing deadtime to seconds and avoiding non-previewed stops.

To do so, first of all a literature review must be done to keep up to date with the current state of art in the field of maintenance. In addition, the whole process and its equipment has to be studied.

When all concepts are clear and the process is completely understood, all relevant equipment and possible components to monitor in the production line have to be identified. The objective is to make a list with all the important equipment for further analysis, in order to classify them depending on its criticality. A total of 88 assets have been analyzed, including pumps, extruders, fans, and rollers.

The methodology followed for this classification is the Criticality Analysis. Its objective is to determine which machines are more essential than others to set in a more efficient way the prioritization of maintenance programs and plans of predictive type. Total criticality considers the impact that the assets have in productivity, quality, safety and maintenance. This is a qualitative method in which these impacts have been worked in ranges and evaluated by weighted factors using engineering criteria and experience. In case of maintenance impact, it has been also studied in a quantitative way. This information helps to know which equipment include in the pilot plant of the production line.

Furthermore, analysis of the current situation has been done simultaneously regarding current breakdowns, maintenance costs and energy consumption. The purpose is to know in which point the company is now in order to investigate what will be the improvements with respect to the current situation with the implementation of the new vibration analysis system. Regarding current breakdowns, it has been analyzed the nature of all the breakdowns that happened in 2021, where they happened, and some important key performance indicators have been used and analyzed such as Uptime, Mean Time To Repair and Mean Time Between Failures. Regarding maintenance costs, it has been studied both, resources of personnel needed in maintenance shutdowns in 2021, and spare parts. Finally, regarding energy consumption, it has been studied the total consumed in a year and the consequent cost of it.

By last, an economic study has been performed and it has been considered the benefits and reductions in cost of implementing predictive maintenance 4.0. The benefit would be that the uptime, time that the production line is working, would increase due to a reduction of non-previewed stops. With this implementation, it would be an increase in uptime, that means an increase in productivity and therefore, an increase in earnings. Also, there would be a reduction of maintenance costs due to the fact that predictive actions would take place instead of preventive or corrective ones, and consequently there would be a reduction of energy consumption.

In order to evaluate different proposals of the implementation, some budgets have been proposed by different suppliers. They all have been evaluated, comparing each of them by their price, annual fee, scope such as measurement points, installation, hardware, software, diagnostic services, start-up and training offered. It has been also evaluated by the payback, that is, the return of the investment, considering the initial investment and the benefits that will be when implementing the predictive maintenance 4.0, that is, increment in uptime translated into an increment of annual benefits, reduction of maintenance costs and reduction of energy consumption. Finally, it has been chosen the best option.