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Tesis

Productivity Increase in the Production Line in the Recharge of Fire Extinguishers Based on Industry 4.0

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Productivity Increase in the Production Line in the Recharge of Fire Extinguishers Based on Industry 4.0

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Abstract—**Fire extinguisher recharging and fire control using dry chemical powder (DPC) are crucial practices globally, especially in view of the alarming increase in fires and the imperative need for operational and effective fire extinguishers. These devices, essential for safety, have an expiry date that makes their periodic maintenance mandatory. In Peru, the companies responsible for recharging fire extinguishers operate under the Peruvian Technical Standard NTP 350.043-1. However, many of these companies carry out the recharging process manually, exposing workers to the risks of handling PQS, a substance harmful to health. In addition, manual procedures are repetitive and susceptible to human error, highlighting the need and potential for adopting advanced technologies to improve efficiency and safety in these processes. The research work focuses on the improvement of the PQS fire extinguisher recharging production line based on Industry 4.0 of the company "Fumisem S.A. C", for which it was necessary to know the processes that perform through a visit, in which a study of times by means of chronometer was made, then to establish the diagram of route, the Diagram of operations of the Process (DOP), The Analytical Diagram of the Process (DAP), which were key to establish the operations, inspections, inputs for each process, likewise the productivity and the unproductivity was seen, on the basis of it the industry 4. 0 where a plant is simulated to scale of the operation of the recharge of fire extinguishers, which was made based on all the requirements and processes described in this work, likewise this work raises the elimination of manpower which will be replaced by industrial automation, on the other hand this type of approach is efficient because the machines do not perform unnecessary movements which improves productivity and times in the recharge of fire extinguishers.**

Keywords—Industry 4.0, production line, fire extinguisher recharging, PQS, time study

I. INTRODUCTION

The maintenance of fire extinguishers in Peru is regulated by the technical standard NTP 350.043-1, which establishes guidelines for the use of halogenated agents. These compounds have been identified for their negative impact on the ozone layer and are listed as controlled substances under the United Nations Environment Programme (UNEP), to which Peru has adhered along with 100 other countries [1]. In the Peruvian context, there is a notable presence of devices without adequate quality certification. For example, companies such as Rally S.A.C. imported more than 60,000 extinguishers using Monoammonium Phosphate with extinguishing agent concentrations as low as 20%, compared to the minimum standard of 75% concentration [2], [3]. Furthermore, a study revealed that out of 538 tonnes of dry chemical powder (DPC) tested, only 40% met the required specifications. It is crucial, therefore, that refilling and maintenance processes in companies are rigorously regulated. The purpose of preventive maintenance and inspection of this fire safety equipment is to ensure that it is in optimal condition for use in emergency situations, thus minimising the associated risks and liabilities [4].

Research in the journal of loss prevention in the process industry, conducted in Russia, focused on the analysis of the production mix of fire extinguishers for fire suppression. The technology industry examined experimental configurations for automated production of solid-propellant gas fillings through water mist. The objective was to increase the inlet pressure of the water, using the stagnation of the process to generate kinetic energy and atomise the water droplets, thus forming a fog. This production method has demonstrated high performance in extinguishing petrol and wood fires [5], [6].

In addition, the Russian Journal of Chemistry has addressed the technological development of extinguishing powders, particularly multifunctional dry powders based on ammonium phosphates. These compounds have been studied in relation to their capabilities to extinguish different types of fires, supported by innovations in production including patented