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Problem analysis to convert pp sticks buds manufacturing machine into paper sticks buds manufacturing machine

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Abstract*—This paper describes various alternatives and modification that can be done to convert polypropylene (plastics) sticks buds manufacturing machine into paper sticks buds manufacturing machine. The project is carried in an industry. As this industry presently produced cotton ear buds in polypropylene (plastics) sticks were to be replaced by paper sticks. Considering the present environmental situation, it was great move to avoid plastic pollution. However this change invited for some challenges to the implementation team. Due to changes in the product different manufacturing process and machinery was needed. This situation presented the need for the purchase of the new machinery. Which machines are not available in India. Machines has to be imported from Switzerland, high initial cost was needed to get these machines. Keeping costs low was the important for the industry considering current economic conditions. Hence, it was decided upon the platform of existing machines. This decision presented company officials with wide range of engineering challenges. Various alternatives for changes to be implemented is discussed in this paper.*

Keywords—cotton ear buds, environment, paper sticks, polypropylene (plastics).

I. INTRODUCTION

1.1 Background of Project

The project is based on modifications which are done in order to convert the machines from manufacturing polypropylene (plastic) sticks to manufacturing paper sticks. Considering the present environmental situation, it was great move to avoid plastic pollution. However this change invited for some challenges to the implementation team. There is many variations in the dimensions of plastic sticks and paper sticks, so the machine modification to make it compatible to this change is to be done. Secondly the material property and adhesiveness of paper is different, so it is necessary to check for other options of gum.As per presently produced cotton ear buds in polypropylene (plastic) sticks were to be replaced by paper sticks. Due to changes in the product different manufacturing process and machinery. Which machines are not available in India machines had to be imported from Switzerland, high initial cost was needed to get these machines. Keeping costs low was important for the industry considering current economic conditions. hence, it was decided to develop upon the platform of existing machines. This changes are tackled in this project.

1.2 Objective of Study

PP sticks having different specifications that paper sticks, it is not possible to manufacture paper sticks on same machine which are used to manufacture pp sticks. One option is to buy new set of machines which is not viable as the initial cost to as 7.5 crore. To overcome this issue it is decided to modify existing machines to fulfil our purpose to manufacture paper sticks. Alternative that has to be found must be cost effective yet reliable and must deliver the product quality that is expected from the industry.

II. PROBLEM DEFINITION

2.1 Problem statement:-

As perpresently produced cotton ear buds in polypropylene (plastics) sticks were to be replaced by paper sticks. Considering the present environmental situation, it was great move to avoid plastic pollution. However this change invited for some challenges to the implementation team. There is many variations in the dimensions of plastic and paper sticks, so the machine modifications to make it compatible to this change is to be done. Secondly the material property and adhesiveness of paper and plastic is different, so it is necessary to check for other options of gum.

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III. PROPOSED METHODOLOGY

3.1 Removal of Heating and Serration process to avoid damage to paper sticks

Presently to manufacture the buds, to stick the cotton swab to the plastic sticks, the sticks are heated and serration was done. However in case of paper sticks if heating is done then there is possibility of damaging the sticks, so the process cannot be followed due to risk involved.

The die presently used for plastic sticks cannot be used for paper stick, as for plastic the sticks were to be heated, followed by serration. However this process cannot be used for paper sticks as there is risk of damaging of sticks. This called for updating of die compatible to new process. Heater will be removed and consequently serration will be removed, this will avoid the problem of paper stick getting damaged. However in this we need to search for new type of gum which can be used directly without this process and even will be used with paper sticks without damaging them.

3.2 Modification of saddle clip as per requirement and dimensions of paper sticks

As there is difference in the dimensions of plastic and paper sticks, there was requirement to change the chain of machine. As per the saddle pin also needs to be adjusted to suit the size of paper stick. This all required a new design and evaluation. Considering the dimensional changes such as length, weight etc. the saddle pin was designed accordingly. Also this new design needs to be manufactured and tested, so that it will not bend or damage the paper sticks. The design modification of saddle film is one of the most important aspects of implementation and efforts are taken accordingly.

3.3 Modification of clip and chain to resolve belt issue

Due to different dimensions the present conveying belt cannot be used. The dimension of belt presently used is as per plastic sticks. The belt facilitates the continuous movement of sticks and ensures it rolls over the gum spread.However if the dimension are different then there is a chance that the gum will not be applied to correct position of stick and also there can be concentration of it on some place, calling for rejection. The belt used to manufacture ear buds presently is mounted on chain using saddle pin. To make it compatible to changed size of paper sticks, we need to modify the design of saddle clip and chain; this change will ultimately change the design of belt. The width of belt needs to be adjusted according to the height of sticks. This change will avoid the problem of bending or damaging of the paper sticks.

3.4 Modification of die

The die presently used for plastic sticks cannot be used for paper stick, as for plastic the sticks were to be heated, followed by serration. However this process cannot be used for paper sticks as there is risk of damaging of sticks. This called for updating of die compatible to new process. The present plastic stick manufacturing die cannot be used as presently the sticks are heated followed by serration which cannot be done in case of paper. So, there is a discussion to have the gum sticking operation in 2 steps.During first step, the application of gum will be done in some quantity which will avoid the sticking of sticks to each other, during second stage of sticking it will increase the finishing of the product.To implement this change there is a requirement to have two new holes, also the position of the holes is required to be designed accurately based on the dimension of stick. The required design for die and required gum is under analysis.

3.5 Check for different type of gum

During preparation of plastic sticks based ear buds, a mixture of IPA + methocyl + water was used. However this mixture's compatibility with paper stick was a doubt. The present gum behaviour against paper sticks is not tested, and this may have risk of damaging a complete lot of paper sticks. Presently used IPA + methocyl +water solution does not hold good with paper sticks. The proportion of this mixture cannot disclose as per companies rule. Tests were performed and accordingly the results were checked which were found not ok, So there is requirement of new gum which can be used for paper sticks, directly also avoiding the process of heating and serration. Presently trials are performed on some examples of gum, shortlisted best on required properties such as viscosity, temperature behavior and adhesiveness. Also after selection of particular gum, the grade of gum has

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to be tested based on all these the selection can be finalized. This is the most critical aspect of project, the selection of gum should be of proper viscosity as this will directly affect the quality of product.

3.6 Change of pump with present available solutions in market

Presently for manufacturing of plastic sticks ear buds, to ensure uniform application of gum on both sides of sticks Lobe type of pump was used. However due to limitation of pump the uniform distribution was lacking often. This caused rejection of ear buds. Presently many scenarios are observed where the pump has found clotting issues. Also as the pump doesn't have direct contact to gum the clotting issues are observed very often. The selection of pump required a lot amount of attention as it is the prime mover of complete project.

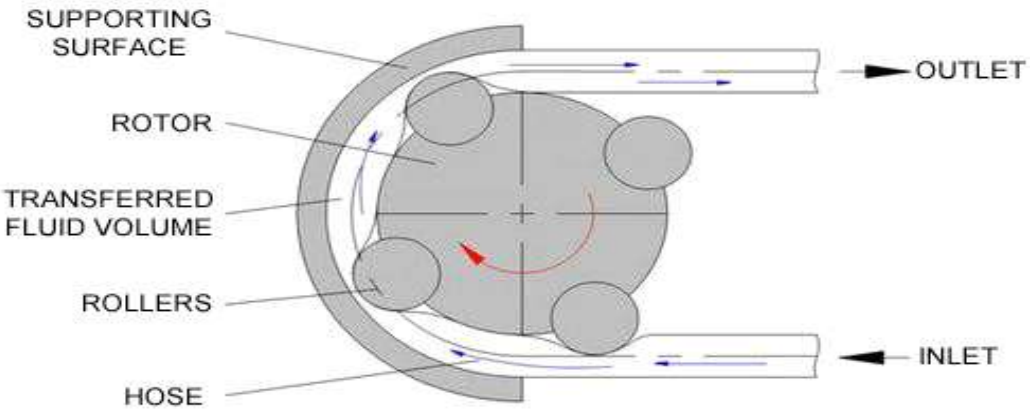

FIGURE 1: Peristaltic pump working

IV. CONCLUSION

The detailed analysis of the problems faced by the industry suggests that the issues regarding machine conversion are solvable and are practical alternative to the purchase of new machines this can be achieved by application of various mechanical principles. Besides cost effectiveness this project is profitable in many ways, from easy availability of new parts in the country to involvement of maintenance staff in this project which causing relatively less need for training program saving industry time. This report, also describes brief literature review done regarding plastic pollution, die modification for different cases, various paper lamination adhesives, overall equipment analysis and development of rotary pumps. Study in depth literature have led to various alternatives to improve on design of machine and other parameters for conversion of machine from plastic stick for bud manufacturing to paper stick for bud manufacturing.

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