ABSTRACT

A part feeder is a system where the parts enter the feeder in all possible orientations and exit the system in a single specified (desired) orientation. These part feeding systems implement a plan, a sequence of gates that push, rotate and even drop parts until they reach the desired orientations. An efficient part feeding planner has the gates sequenced so that most of the entering parts, exit the system in the desired orientation. For many types of automated manufacturing equipment, there is a requirement to supply them with parts which invariably need to be presented in a single orientation.

A brake pad which is an irregular component has been considered in this research work. Automation has become essential for such components. The part feeding system is important for such products which help in reducing the lead time to meet the necessity. In order to fulfill this need and also after realizing the importance of part feeding system for brake pad manufacturing industry, a system is developed during the research work which is reported in this thesis.

The research work started with the study of various methods to analyze and implement the part feeders developed by earlier researchers taking a reference from the literature. After this, drop test is conducted for finding the possible orientations and most favorable orientation of a part (brake pad). Here two methods of drop test are conducted experimentally to find the most favorable orientation of part. Theoretical methods like energy barrier method, stability

method, critical solid angle method and centroid solid angle method are also used to identify the most favorable orientation of part. The outcome of the drop test and theoretical methods are compared to finalize the most favorable orientation of the part.

After finding the most favorable orientation of the part, the singularizing unit and trap is designed and tested. The singularizing unit is designed to separate the brake pads from clusters and to singularize them. The singularizing unit is designed by using Markov model and the unit is fabricated. Experiments are conducted for selecting the suitable parameters by keeping the unit at various levels of inclinations by using base plates of various thicknesses. The dynamic simulation is carried out using ADAMS software for finding the best parameters of singularizing unit. Trap is the heart of the system to change the possible orientations to most favorable orientation of the part. A suitable trap is designed using Markov model for the brake pad. The innovative trap is studied experimentally and the best parameters are found using real time experiments. Real time experiments are carried out by using Lab VIEW software and the dynamic simulation is carried out using ADAMS software for finding the best parameters of the trap.

The parameters of trap are statistically studied by the experiments designed using Taguchi's method and analysed using ANOVA. The study of S/N ratios obtained as a result from this technique is very useful in identifying the major factors contributing to the output function. A regression equation is formed to identify the strength of the independent variables on the acceleration of part. This linear regression equation is solved using LINGO software for finding the

global optimal solution. Outcome of the real time experiments, dynamic simulation and optimization are compared for finding the optimum parameters of trap for effective part motion. Field test using the new innovative part feeding system is conducted to reduce the lead time of brake pad manufacturing industry. On the whole, it is stated that, innovative part feeding system will facilitate the industrial engineers and managers to reduce the lead time and improving productivity for brake pad manufacturing industry.