CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The case company for this research has faced the problem of breakage in the production of PP bands. This breakage causes the company higher manufacturing cost due to loss of material and labour productivity. The company was at the competitive disadvantage when it has to compete based on price to win the customers. The critical point of breakage occurred at stretching oven in the stretching process of PP-band line. This process is the most important and vulnerable point where there are high rate of PP-band breakage. Thus, in order to achieve the production goal of manufacturing PP bands at the low cost relative to that of competitors, FMEA technique was used to solve the breakage problem in PP-band line by implementing FMEA in the line in problem before applying FMEA in other lines for further improvement in the company.

FMEA technique was applied by forming FMEA team from various departments such as process, maintenance and production to solve PP-band breakage problems at the stretching process. FMEA team includes the production manager, production engineer, production supervisor, and line operators of the case company. FMEA team systematically brainstorms and analyzes the process of PP bands to identify failure modes at each process step of stretching process. Data is collected in order to select one type of PP bands that is most appropriate for sample study of applying FMEA to solve the breakage problem. FMEA boundaries were determined. PP-band process flowchart and Cause & effect diagram were brainstormed to aid the analysis.

After brainstorming, the team found that three factors that could be causes of breakage. These factors are bubbles in quenching bath, band speed in stretching oven and stretching oven temperature. Analysis for causes of breakage was done systematically through Process FMEA form. Design of experiment (DOE) was employed to find the real cause of breakage. Three-factor experiment was conducted for a statistical analysis of the impact on stretching oven temperature, band speed in stretching oven and bubbles in

chilled water of quenching bath. The result from the effect calculations show that bubbles is the cause of PP-band breakage because the calculated effect of bubbles is high while the calculated of other factors remain low. Moreover, normal probability distribution graph reveals that bubbles factor in chilled water of quenching bath is significant because the t-statistic value of bubbles factor fall into rejection area. All the other factors and interactions of factors fall within the upper and lower decision limits. From Analysis of Variance (ANOVA), only bubbles factor was significant while the other factors do not play a role in increasing the variability in the counted breakage times.

After applying FMEA technique, it was found that bubbles are the real cause of breakage of PP bands in the production line. Bubbles which were found in chilled water of quenching bath were cause of breakage in stretching oven of stretching process. PP bands from extruder were extruded with high temperature before it is directly cooled down in quenching bath for band setting. At this sensitive point, small bubbles particles formed into big bubbles particles directly touched and destroyed surface of PP bands. Deforming PP bands for band setting in quenching bath was quite vulnerable for any particles which can destroy surface of band. Consequently, the breakage of PP bands which happened during stretching process is because abnormal physical form of PP bands which is further stretched in stretching oven can be easily broken.

Corrective action is done after the real cause of breakage is found. The team found that the bubbles happened in chillers at electric centrifugal pump (water pump) because there was the leakage in water flow system at water pump. Therefore, to prevent the leakage it is needed to change the O-ring seal in water pump. As a result, the bubbles in chilled water of quenching bath are eliminated in the process and the breakage times and loss have been eliminated in the production system both in study sample and other types of PP bands in study production line. The results of RPN were put in process FMEA form of action results phrase which is reduced to 64 from 640. Consequently, this confirmed that the breakage problem of PP bands in the line of case company has already been solved satisfactorily.

This research achieves the objective of eliminating breakage problem in the PP-band line of the case company. There are lots of benefits obtained from this research,

including reduced production cost, increased machine productivity, and reduced machine maintenance time. Other benefits include meeting the production schedule and building awareness of applying FMEA in the case company. Furthermore, this research can be used as a case study to apply the FMEA technique in other area to improve production of the case company.

6.2 Recommendation

The results of this study will be helpful for management of the case company because they indicate that for future improvement the case company needs to implement preventive maintenance program in the production department. Applying FMEA technique to solve breakage problem of PP-band line reveals that bubbles which are the real cause of breakage problem results from lack of proper preventive maintenance in the case company. The maintenance activity is urgently required for preventive maintenance in the case company to minimize breakdown in the production line and maximize machine and labour productivity. Periodic inspection and preplanned maintenance activities should be done to avoid future problem.

Preventive maintenance would be especially beneficial to those plants that rely on breakdown or run-to-failure maintenance. Preventive maintenance is planned maintenance of plant and equipment that is designed to improve equipment life and avoid any unplanned maintenance activity. Its main purpose is to minimize breakdowns and excessive depreciation in the company. Neither equipment nor facilities should be allowed to go to the breaking point. Preventive maintenance program can occur through painting, lubrication, cleaning and adjusting, and minor component replacement to extend the life of equipment and facilities.

Furthermore, it is further recommended that the case company establish preventive maintenance not only in production department but also in other departments of the case company in order to improve quality, reliability, and safety of all process in the company. However, a preventive maintenance program is potentially risky. Therefore it must be administered and performed properly to be successful. In order to minimize

risk, preventive maintenance has to be carefully planned and carried out by well-trained and motivated workers. In addition, even though there are many advantages for having a good preventive maintenance program in the company, the top management should weigh the associated cost of implementing preventive maintenance against the increased benefits. To be successful, the perceived benefits of having preventive maintenance program should outweigh the involved costs of implementation.

Finally, it should be taken in consideration that preventive maintenance can help prevent only the occurrence of unforeseen causes. However, if the problem of production still exists, it is suggested that the case company should apply FMEA technique in that area of the factory. For instance, if preventive maintenance program cannot help to solve the problem of breakage from other causes such as irregular cleaning of filter in the extruder, FMEA technique may be employed to find and eliminate the real causes of the problem.