CHAPTER V

CONCLUSIONS

5.1 Conclusion

The simulation of batch scheduling for suspension polyvinyl chloride production process is examined. This production contains 2 batch reactors in parallel and continuous production in down stream process. This simulation is taken the constrained of one single unit of utilities supply for both reactors. The utilities is requested feeding depend on phase along batch time. The other constrained are limitation of discharge tank volume in space and minimum and maximum level acceptance. After that, discharge model of tank drainage by gravity is applied. All these constrained is considered and simulated in model in order to find the optimal discharge flow rate out off degasser (DGZ). The performance and effectiveness of the proposed simulation handling scheme compared between programming in Matlab R2009b and real process production by comparison with 42 batches in 7 days. The simulation is verified and corrected until it can be represented the real process. It is applied differential evolutionary algorithm (DE) technique with the proposed constraint handling schematic to be met optimization problems following objective function which is maximum production in time horizon. The time horizon in this studying is 1440 min (1day). By trial, it can be found that the optimal absolute time for both reactors can be started in order to get maximum production in time horizon and in limit of all constrained. The problem is run 10 times with 100 different seeds to random number generator in order to check the consistency of the result obtained. It is found that the starting batch time in one day following this technique can increase production from average production 390 ton/day to 465 ton/day. It is increasing around 19%. The benefit from this scheduling is around 3.27 Million US Dollar/year when we consider plant in service 330 days in annual. So, the simulation and optimization for finding optimal batch scheduling is useful because it can increase production rate without any addition equipment or specific investment. It is also avoided impact from trial error in the production plant which will be possible to consume cost, time and improper raw material, impacted to safety and plant productivity.

5.2 Recommendations

Therefore, the result of optimal batch schedule is occurred by manual operation with the real production and fix time horizon in period one day. So, it will be useful, if it can be applied to operate with out manual intervention such as by upgrade programming the scheduling in distributed control system (DCS) of this production line. It is also advantage, if we increase time horizon more than 1 day to cover all operation campaign of plant production following company plan.

The capacity of equipment is directly impacted to production especially available volume of DGZ. We can consider this impact in equation 3.13. This equation is for finding $F\ min$ (minimum flow rate of slurry out off DGZ). If V_{max} is increased, $F\ DGZ$ will be increased. Fortunately, during studying the author found

that DGZ volume calculation which was used for plant calculation had remained margin. The existing plant is calculated the volume by considered only the volume only cylindrical part of ellipsoidal (2:1) vessel. They do not consider the volume both side of caps of this vessel. The volume include both caps is increased to 210 m^3 while the existing considered volume is 180 m^3. The detail of calculation is in Appendix 2. Therefore, the author studying use DGZ volume at 180 m^3 for his calculation because all plant, equipment, instrument and distributed control system are used this value for DGZ volume. The studying should not have compared, if the new value was applied.

Polymerization is exothermic reaction. This process production is used chilled water 4 C^o in order to remove heat from reaction by circulated through double jacket of autoclave both AC1, AC2 and other reactors in plant. Chilled water is produced from chiller which is high electrical consumption (1460 kW per 3 machines, normally service 3 machines). This study allows us to know batch starting time, so the period of batch is known as well. If we can simulate all reactors in plant, we will know batch time and period of chilled water required. So, we can use these valued data for chiller management.