CHAPTER V

CONCLUSION

5.1 Introduction

This work has presented an approach to the design of plant wide control systems. The approach is based on heuristic in nine step of plant wide control strategy to design the control structures of Vinyl Acetate process. Dynamic simulations of Vinyl acetate process can be presented in two points.

1. The effects of temperature reactor changing to production rate of vinyl acetate.
2. The effects of total acetic acid changing to production rate of vinyl acetate.

The production rate of vinyl acetate depends on reactor temperature and ethylene feed flowrate. This work, the control structures is tested by changing the reactor temperature and total acetic feed. For the results, production rate increases when the reactor temperature increases and decreases when reactor temperature decreases. The increase the total acetic acid feed leads to the production rate decrease and the temperature decrease in column because of more feed in column.

5.2 Control Structures Comparison

This work has presented three designed control structures to compare with reference structure that presented by Luyben. The dynamic simulation of this process reacts to various disturbances and changes in operating conditions.

5.2.1 Decrease reactor temperature

The designed control structures and reference structure results are similar. The CS1 and CS4 structures reach the new setpoint at time 40 minutes. The CS2 and CS3 structures get the new setpoint at time 35 minutes that is faster than CS1 and CS4 structures. The response of total acetic acid recycle flowrate loop more drastic in CS2 and CS3 structures because of the different manipulator in this loop. The CS4 structure produces smallest amount of vinyl acetate product because the fresh ethylene is fixed. From the IAE, the CS2 structure is the most effective reactor temperature loop.

5.2.2 Increase reactor temperature

The increase in reactor temperature increases the production rate and fresh feed because of high reaction rate. Although, the responses of the increase reactor temperature are more oscillatory than the decrease, the times that reach to the setpoint are faster than. From the IAE, the CS2 structure is the most effective reactor temperature loop.

5.2.3 Increase total acetic acid

The CS2 and CS3 structures are resulted in faster dynamic response than the CS1 structure in flow controlled of total acetic acid loop. Because they are controlled the total flow of acetic acid by manipulating the fresh acetic feed that is a direct effect. The production of vinyl acetate decreases when the total flow acetic acid increases because of the unusual reaction rate of vinyl acetate reaction. For the change in column, CS2 and CS3 give the less deviation of acetic acid in the organic product. From the IAE, the CS2 structure is the most effective reactor temperature loop.

All of control structures can operate to achieve the objective and within process constraints. The oxygen composition is remain the safety constraint The performances of all control structures can present in IAE value and can compared their performance with IAE value. Table 5.1, 5.2, and 5.3 show IAE value of each structure. From the IAE value the CS2 control structure is the most effective control structure because it give the fast response to reject disturbance and minimizing the deviation of the product quality.

Table 5.1 IAE result

(a) Decrease reactor temperature

	Oxygen composition	Reactor temperature	Column temperature	Column pressure	Decanter temperature	Total HAc flow	sum IAE
CS1	0.1542	0.2675	0.0056	0.0052	0.2535	0.0584	0.7444
CS2	0.1544	0.2638	0.0011	0.0020	0.2180	0.0271	0.6663
CS3	0.1543	0.2624	0.0973	0.0102	0.3100	0.0334	0.8677
CS4	0.1605	0.4011	0.0015	0.0053	0.2199	0.0422	0.8305

(b) Increase reactor temperature

	Oxygen composition	Reactor temperature	Column temperature	Column pressure	Decanter temperature	Total HAc flow	sum IAE
CS1	0.1201	0.2213	0.0063	0.0049	0.1379	0.0910	0.5816
CS2	0.1202	0.2169	0.0020	0.0034	0.2075	0.0340	0.5840
CS3	0.1201	0.2177	0.0960	0.0078	0.3238	0.0312	0.7966
CS4	0.1294	0.3054	0.0021	0.0047	0.2112	0.0285	0.6814

(c) Increase total acetic acid

	Oxygen composition	Reactor temperature	Column temperature	Column pressure	Decanter temperature	Total HAc flow	sum IAE
CS1	0.0289	0.0891	0.0111	0.0061	0.1645	1.5777	1.8774
CS2	0.0265	0.0952	0.0055	0.0058	0.2401	0.3652	0.7384
CS3	0.0263	0.0975	0.1284	0.0102	0.3257	1.4125	2.0006
CS4	0.0260	0.0701	0.0034	0.0031	0.2820	0.6560	1.0406

5.3 Recommendations

1. Check the energy consumption of all control structures to analyze the structure that is the most economical.

2. Design the new structure that uses the bypass valve on feed effluent heat exchanger to ensure that liquid phase does not occur in heat exchanger.