CHAPTER 5

RESEARCH RESULT

This chapter divided the result in two parts as follows.

5.1 Model for rinsing of recycled plastic

In this part, we explain how to formulate the mathematical model. The model represents the dynamic response of cleaning agent concentration in three stages of rinsing, which we provide to improve the rinsing process in the recycled plastic plant.

From the equation of rinsing model (Equation 4.1 to 4.3), the variables in these equations such C_0, V, d ...etc. with constant value are be determined from the experimental condition as shown in table 5.1

Table 5.1 Summary of the experiment condition.

List	Variables	Unit	Value
Initial of cleaning agent concentration	C_o	g/l	5
Each of rinsing tank volume	V	liters	20
Drag out volume	d	liters	0.7
Holding time	t_D	sec.	6

The value of variables (b_1, b_2 and b_3) are be given by best fitting between theorical curve and experimental point. The result of formulating rinsing model is shown as figure 5.1 to 5.6.

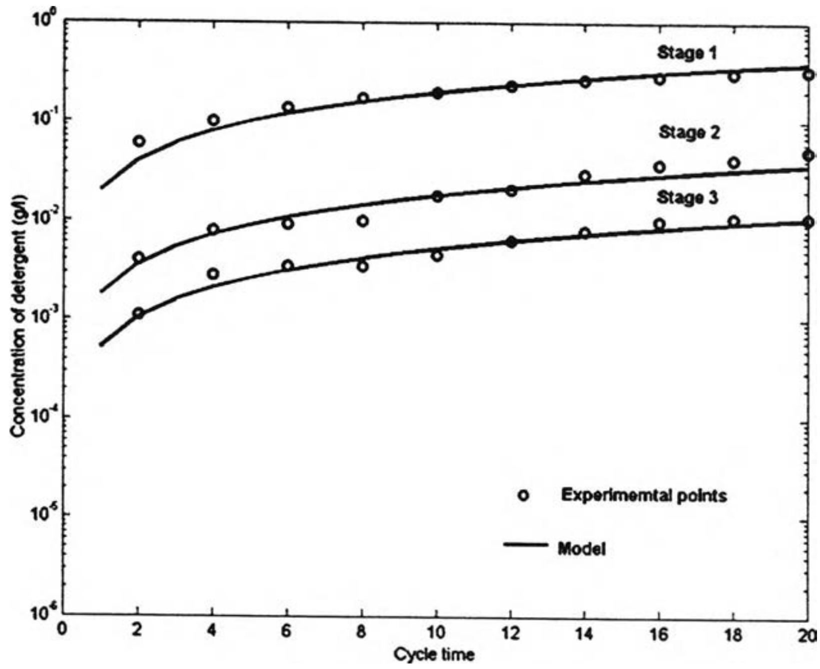

Figure 5.1 Concentration in three rinse stages for a rinsing time of 5 seconds

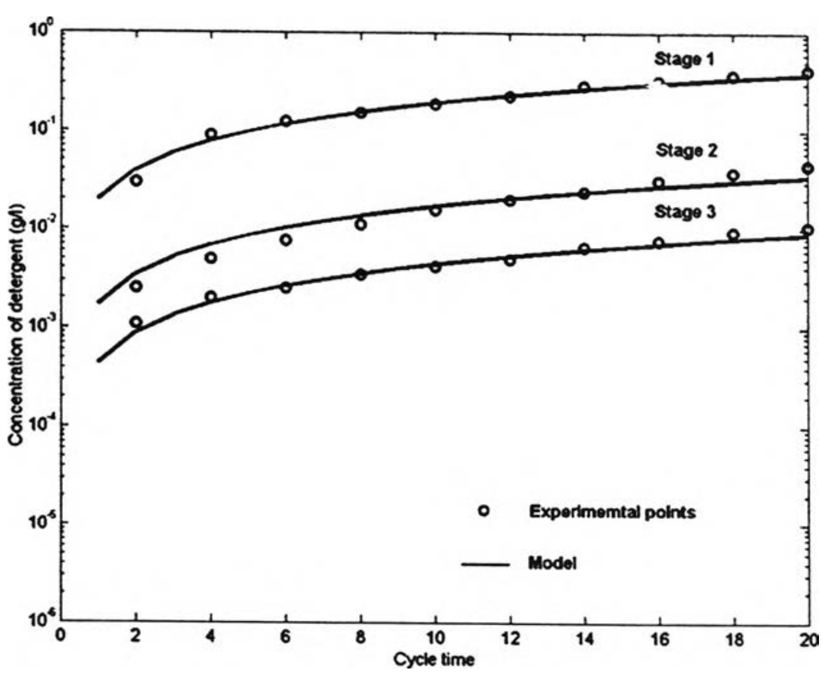

Figure 5.2 Concentration in three rinse stages for a rinsing time of 10 seconds

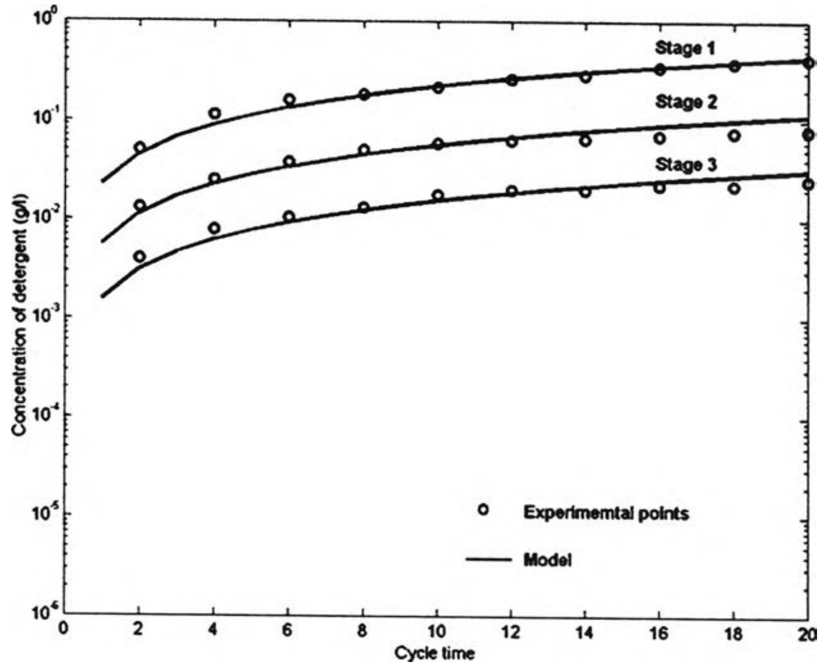

Figure 5.3 Concentration in three rinse stages for a rinse time of 15 seconds

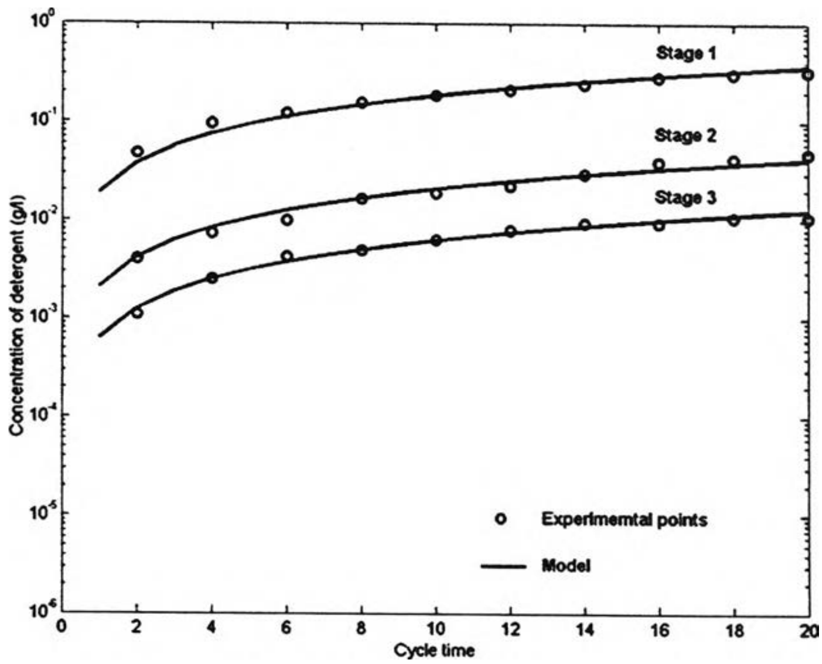

Figure 5.4 Concentration in three rinse stages for a rinsing time of 20 seconds

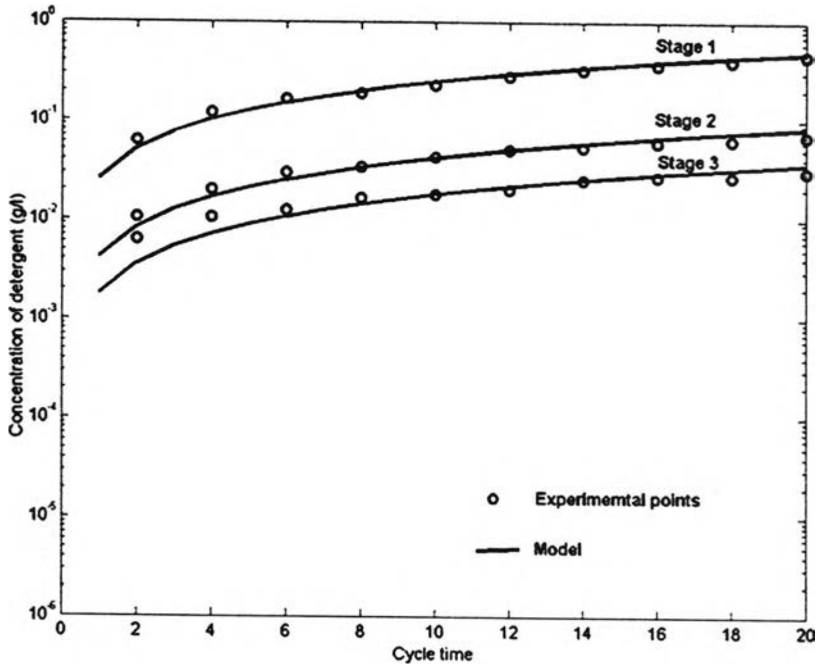

Figure 5.5 Concentration in three rinse stages for a rinsing time of 25 seconds

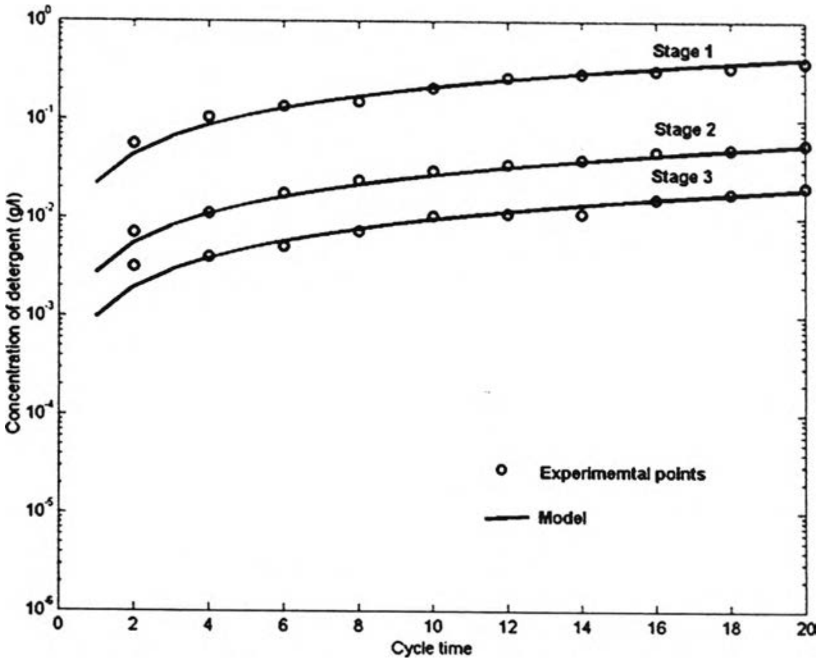

Figure 5.6 Concentration in three rinse stages for a rinsing time of 30 seconds

The solid line in figure 5.1 to 5.6, which represents the theoretical curve of cleaning agent concentration in rinsing stages after rinsing at various of cycle time of rinsing, can calculate from equation below.

5 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-7.95 \times 10^{-4} \times t\right) \quad (5.1)$$

$$Z_2 = 5 + 0.1705 \times \exp\left(-7.95 \times 10^{-4} \times t\right) - 5.1705 \times \exp\left(-9.54 \times 10^{-5} \times t\right) \quad (5.2)$$

$$Z_3 = 5 + 0.0451 \times \exp\left(-7.95 \times 10^{-4} \times t\right) - 0.0665 \times \exp\left(-9.54 \times 10^{-5} \times t\right)$$

$$-5.112 \times \exp\left(-2.86 \times 10^{-5} \times t\right) \quad (5.3)$$

10 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-3.94 \times 10^{-4} \times t\right) \quad (5.4)$$

$$Z_2 = 5 + 0.1062 \times \exp\left(-3.94 \times 10^{-4} \times t\right) - 5.1060 \times \exp\left(-4.16 \times 10^{-5} \times t\right) \quad (5.5)$$

$$Z_3 = 5 + 0.0252 \times \exp\left(-3.94 \times 10^{-4} \times t\right) - 0.0347 \times \exp\left(-4.16 \times 10^{-5} \times t\right)$$

$$-5.060 \times \exp\left(-2.86 \times 10^{-5} \times t\right) \quad (5.6)$$

15 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-3.01 \times 10^{-4} \times t\right) \quad (5.7)$$

$$Z_2 = 5 + 0.3960 \times \exp\left(-3.01 \times 10^{-4} \times t\right) - 5.3960 \times \exp\left(-9.19 \times 10^{-5} \times t\right) \quad (5.8)$$

$$Z_3 = 5 + 0.0809 \times \exp\left(-3.01 \times 10^{-4} \times t\right) - 0.1218 \times \exp\left(-9.19 \times 10^{-5} \times t\right)$$

$$- 5.203 \times \exp\left(-2.67 \times 10^{-5} \times t\right) \quad (5.9)$$

20 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-1.89 \times 10^{-4} \times t\right) \quad (5.10)$$

$$Z_2 = 5 + 0.1033 \times \exp\left(-1.89 \times 10^{-4} \times t\right) - 5.1035 \times \exp\left(-2.43 \times 10^{-5} \times t\right) \quad (5.11)$$

$$Z_3 = 5 + 0.0281 \times \exp\left(-1.89 \times 10^{-4} \times t\right) - 0.0404 \times \exp\left(-2.43 \times 10^{-5} \times t\right)$$

$$- 5.069 \times \exp\left(-7.43 \times 10^{-6} \times t\right) \quad (5.12)$$

25 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-2.03 \times 10^{-4} \times t\right) \quad (5.13)$$

$$Z_2 = 5 + 0.2250 \times \exp\left(-2.03 \times 10^{-4} \times t\right) - 5.2250 \times \exp\left(-4.07 \times 10^{-5} \times t\right) \quad (5.14)$$

$$Z_3 = 5 + 0.0839 \times \exp\left(-2.03 \times 10^{-4} \times t\right) - 0.1505 \times \exp\left(-4.07 \times 10^{-5} \times t\right)$$

$$- 5.235 \times \exp\left(-2.16 \times 10^{-5} \times t\right) \quad (5.15)$$

30 seconds of rinsing time

$$Z_1 = 5 - 5 \times \exp\left(-1.46 \times 10^{-4} \times t\right) \quad (5.16)$$

$$Z_2 = 5 + 0.1289 \times \exp\left(-1.46 \times 10^{-4} \times t\right) - 5.1290 \times \exp\left(-2.13 \times 10^{-5} \times t\right) \quad (5.17)$$

$$Z_3 = 5 + 0.0412 \times \exp\left(-1.46 \times 10^{-4} \times t\right) - 0.0645 \times \exp\left(-2.13 \times 10^{-5} \times t\right)$$

$$- 5.106 \times \exp\left(-7.76 \times 10^{-6} \times t\right) \quad (5.18)$$

From the equation 5.1 to 5.18, the imperfect mixing coefficients are obtained from the best fit of the theoretical curve to the experimental point. The values of these coefficients in each rinsing tank are listed in table 5.2.

Table 5.2 Value of the imperfect-mixing coefficients for various rinsing times.

Run	Rinsing time (sec.)	Imperfect-mixing coefficients		
		Stage-1	Stage-2	Stage-3
1	5	0.75	0.970	0.991
2	10	0.82	0.981	0.995
3	15	0.82	0.945	0.984
4	20	0.86	0.982	0.995
5	25	0.82	0.964	0.984
6	30	0.85	0.978	0.992

The value of the imperfect-mixing coefficient can express the condition of agiation in each rinsing tank which has highest of agiation in the first tank and least of agiation in the third tank (the value is nearly one).

Above the model of rinsing process, we focus on the cleaning agent concentration at the last tank which we normally use to set criterion of discharge water in each tank and fill new fresh water in these tanks. We interest to consider the effects of volume of rinse water and drag out volume. Thus we apply this model to find the concentration at the last tank at various of volume of rinse water and drag out volume (50 to 150 percentage of ordinary value) as shown in figure 5.7-5.18.

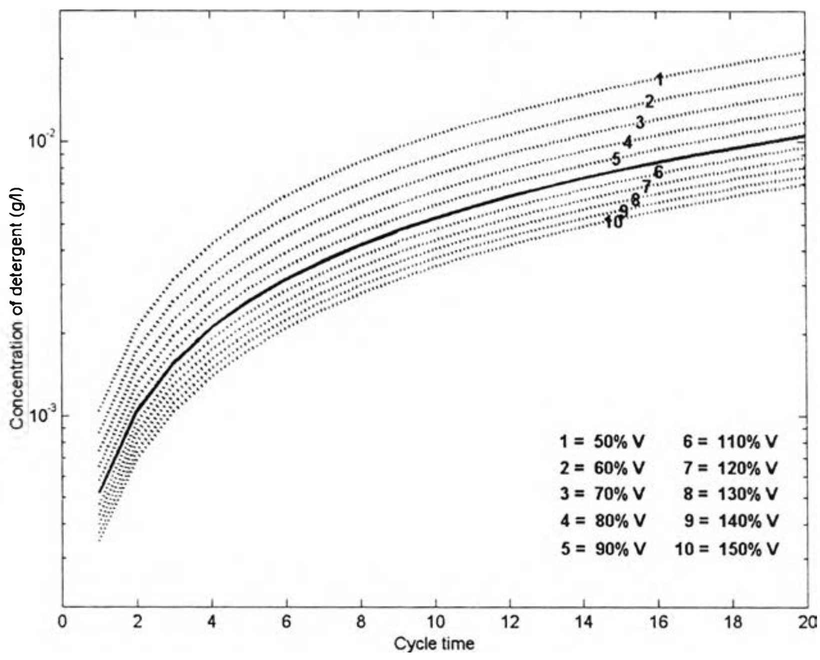

Figure 5.7 Concentration at the last tank at various volume of rinse water for rinsing time 5 seconds

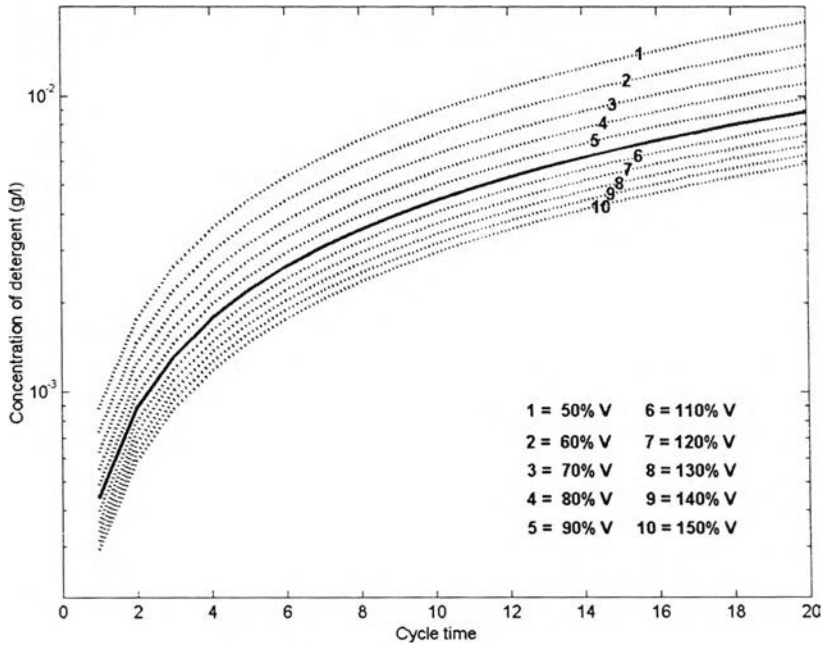

Figure 5.8 Concentration at the last tank at various volume of rinse water for rinsing time 10 seconds

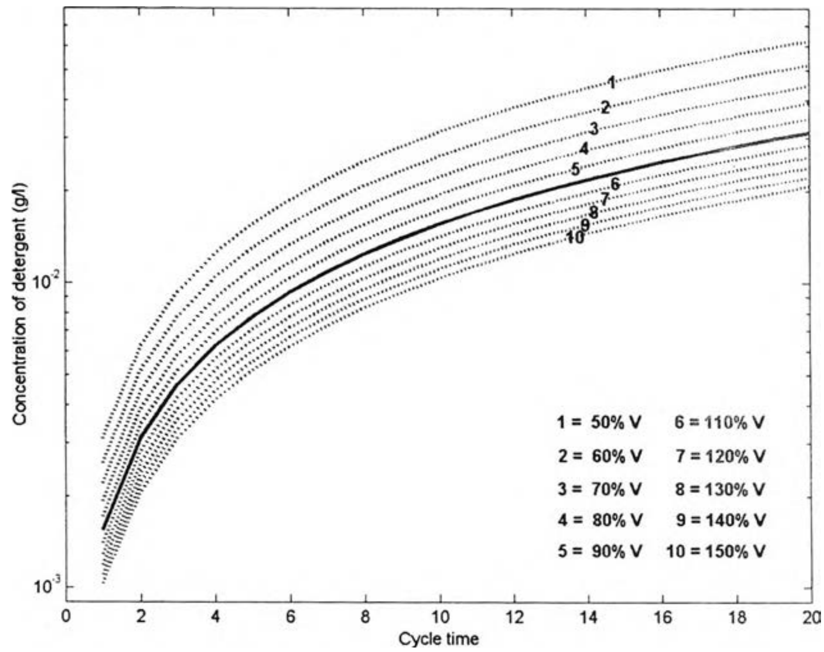

Figure 5.9 Concentration at the last tank at various volume of rinse water for rinsing time 15 seconds

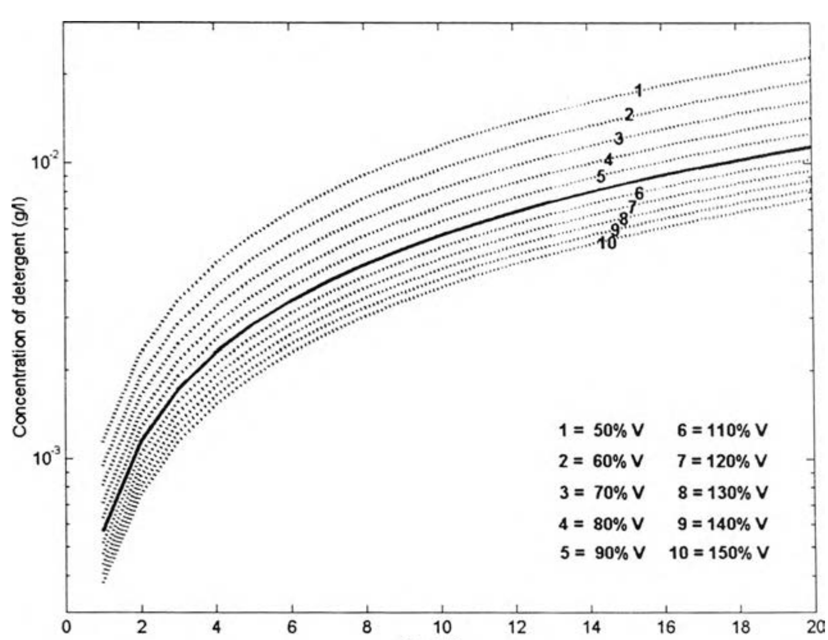

Figure 5.10 Concentration at the last tank at various volume of rinse water for rinsing time 20 seconds

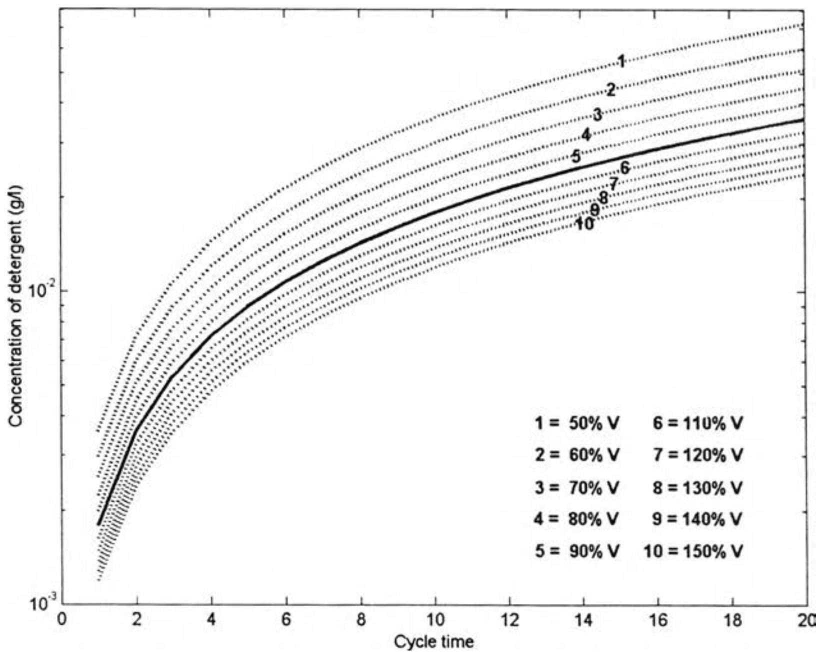

Figure 5.11 Concentration at the last tank at various volume of rinse water for rinsing time 25 seconds

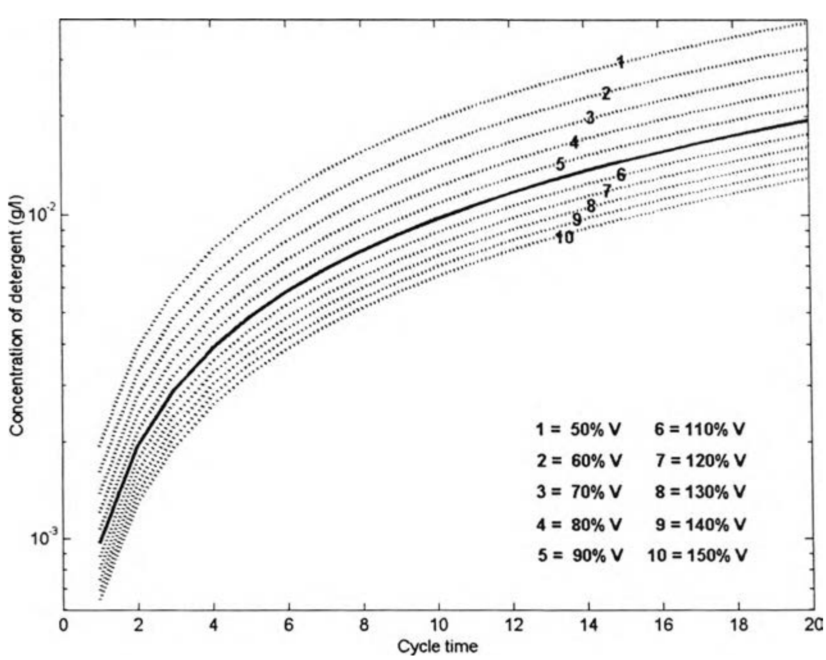

Figure 5.12 Concentration at the last tank at various volume of rinse water for rinsing time 30 seconds

From the result of simulation at various volume of rinse water (90 to 150 percentage of ordinary value), the concentrations of cleaning agent at twenty cycle time of rinsing in the last tank are be listed in table 5.3 to 5.4.

Table 5.3 Value of the concentration at the last tank for various volume of rinse water.

Rinse water volume	Concentration at the last tank (g/l)					
	Rinsing time 5 sec.		Rinsing time 10 sec.		Rinsing time 15 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
150%V	0.0069	-33.01	0.0058	-33.33	0.0204	-33.11
140%V	0.0074	-28.16	0.0062	-28.74	0.0219	-28.20
130%V	0.0079	-23.30	0.0067	-22.99	0.0235	-22.95
120%V	0.0086	-16.50	0.0073	-16.09	0.0255	-16.39
110%V	0.0093	-9.71	0.0079	-9.20	0.0278	-8.85
100%V	0.0103	-	0.0087	-	0.0305	-
90%V	0.0114	10.68	0.0097	11.49	0.0338	10.82
80%V	0.0128	24.27	0.0109	25.29	0.0380	24.59
70%V	0.0146	41.75	0.0124	42.53	0.0433	41.97
60%V	0.0169	64.08	0.0144	65.52	0.0504	65.25
50%V	0.0202	96.12	0.0173	98.85	0.0602	97.38

Table 5.4 Value of the concentration at the last tank for various volume of rinse water (Continued).

Rinse water volume	Concentration at the last tank (g/l)					
	Rinsing time 20 sec.		Rinsing time 25 sec.		Rinsing time 30 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
150%V	0.0075	-33.63	0.0236	-32.95	0.0128	-33.33
140%V	0.0081	-28.32	0.0252	-28.41	0.0137	-28.65
130%V	0.0087	-23.01	0.0271	-23.01	0.0148	-22.92
120%V	0.0094	-16.81	0.0294	-16.48	0.0160	-16.67
110%V	0.0103	-8.85	0.0320	-9.09	0.0174	-9.38

Rinse water volume	Concentration at the last tank (g/l)					
	Rinsing time 20 sec.		Rinsing time 25 sec.		Rinsing time 30 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
100%V	0.0113	-	0.0352	-	0.0192	-
90%V	0.0125	10.62	0.0390	10.80	0.0213	10.94
80%V	0.0141	24.78	0.0438	24.43	0.0239	24.48
70%V	0.0161	42.48	0.0499	41.76	0.0272	41.67
60%V	0.0187	65.49	0.0580	64.78	0.0317	65.10
50%V	0.0224	98.23	0.0692	96.59	0.0379	97.40

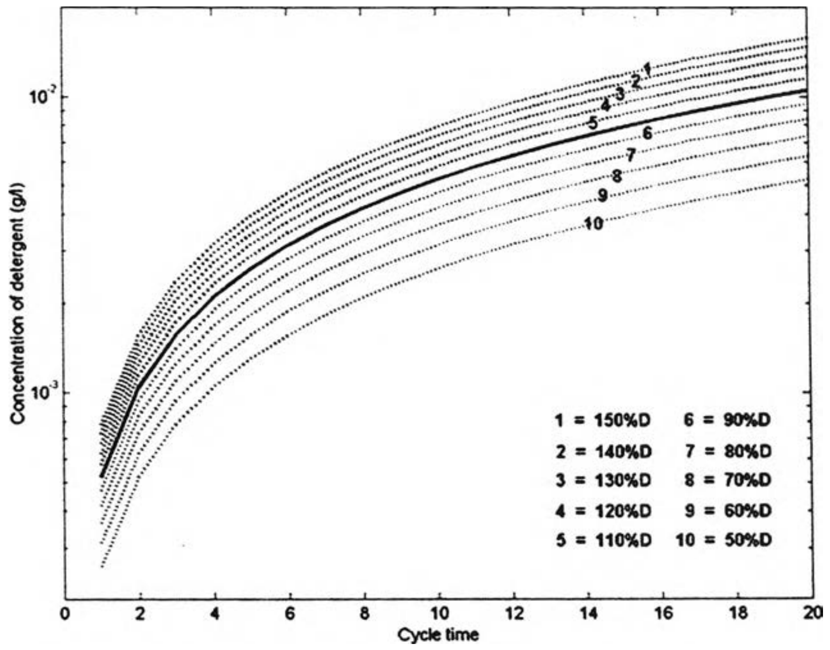

Figure 5.13 Concentration at the last tank at various volume of drag out for rinsing time 5 seconds

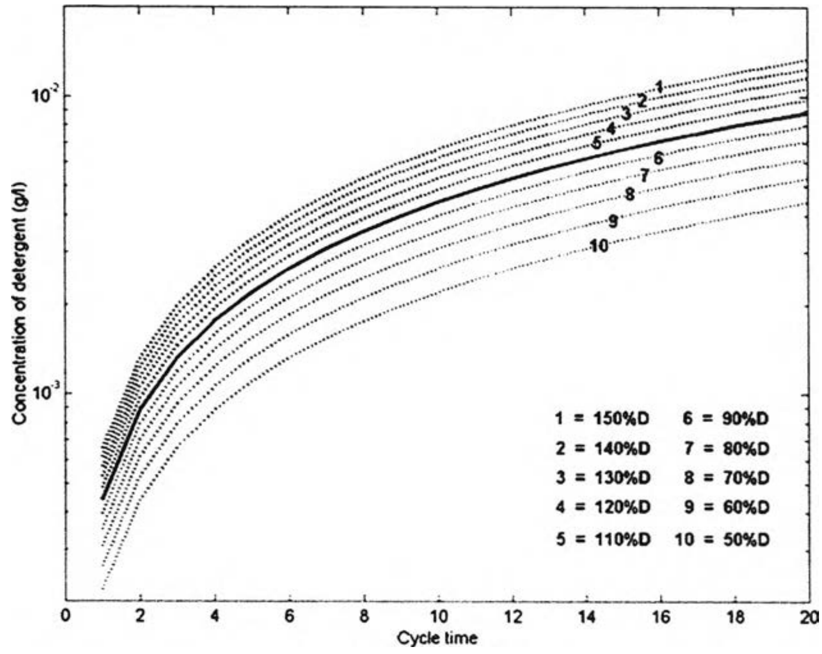

Figure 5.14 Concentration at the last tank at various volume of drag out for rinsing time 10 seconds

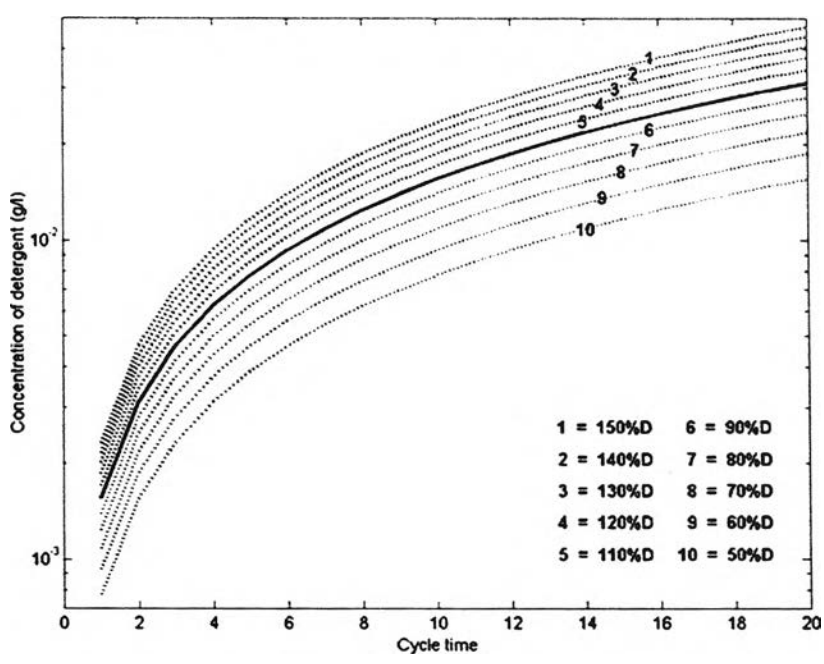

Figure 5.15 Concentration at the last tank at various volume of drag out for rinsing time 15 seconds

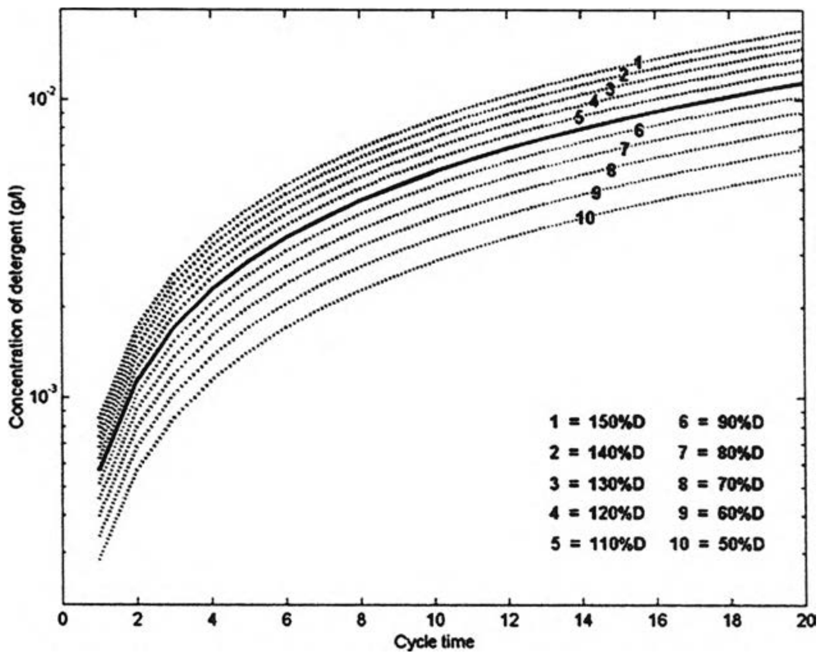

Figure 5.16 Concentration at the last tank at various volume of drag out for rinsing time 20 seconds

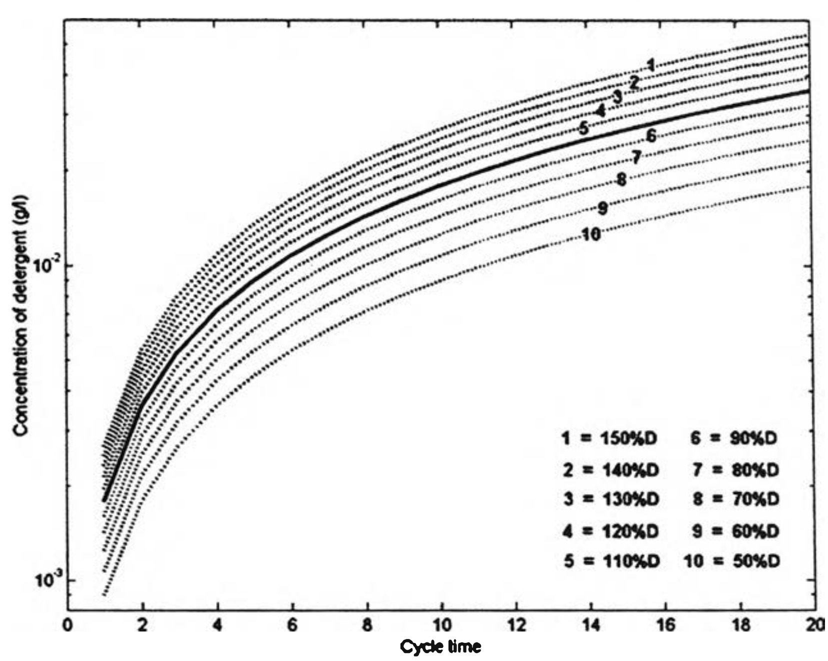

Figure 5.17 Concentration at the last tank at various volume of drag out for rinsing time 25 seconds

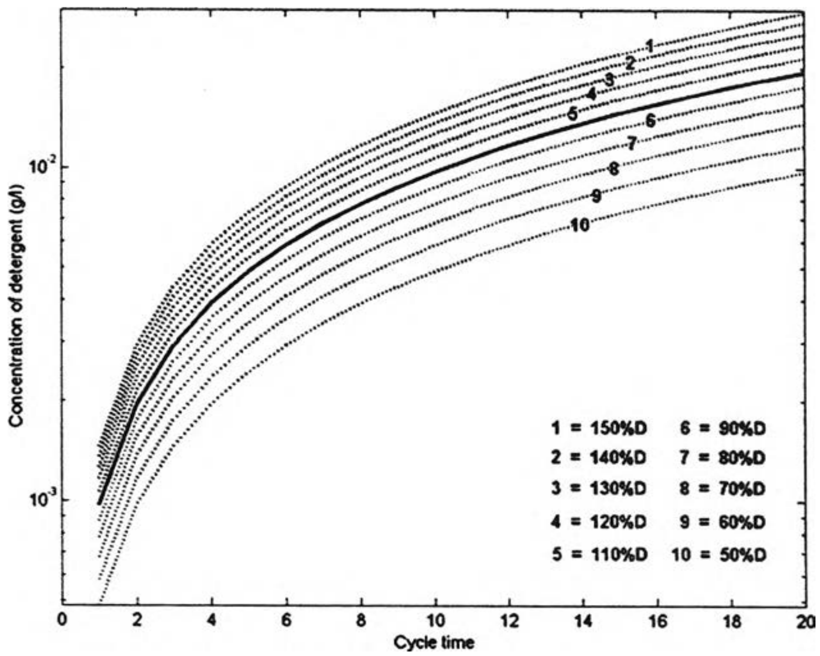

Figure 5.18 Concentration at the last tank at various volume of drag out for rinsing time 30 seconds

From the result of simulation at various volume of drag out (90 to 150 percentage of ordinary value), the concentrations of cleaning agent at twenty cycle time of rinsing in the last tank are be listed in table 5.5 to 5.6.

Table 5.5 Value of the concentration at the last tank for various volume of drag out.

Drag out volume	Concentration at the last tank (g/l)					
	Rinsing time 5 sec.		Rinsing time 10 sec.		Rinsing time 15 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
150%d	0.0153	48.54	0.0130	49.43	0.0454	48.85
140%d	0.0143	38.83	0.0122	40.23	0.0425	39.34
130%d	0.0133	29.13	0.0113	29.89	0.0395	29.51
120%d	0.0123	19.42	0.0104	19.54	0.0365	19.67
110%d	0.0113	9.71	0.0096	10.34	0.0335	9.84
100%d	0.0103	-	0.0087	-	0.0305	-
90%d	0.0092	-10.68	0.0079	-9.20	0.0275	-9.84

Drag out volume	Concentration at the last tank (g/l)					
	Rinsing time 5 sec.		Rinsing time 10 sec.		Rinsing time 15 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
80%d	0.0082	-20.39	0.0070	-19.54	0.0245	-19.67
70%d	0.0072	-30.10	0.0061	-29.89	0.0215	-29.51
60%d	0.0062	-39.81	0.0053	-39.08	0.0184	-39.68
50%d	0.0052	-49.51	0.0044	-49.43	0.0154	-49.51

Table 5.6 Value of the concentration at the last tank for various volume of drag out (Continued).

Drag out volume	Concentration at the last tank (g/l)					
	Rinsing time 20 sec.		Rinsing time 25 sec.		Rinsing time 30 sec.	
	Z_3	% Diff	Z_3	% Diff	Z_3	% Diff
150%d	0.0168	48.67	0.0523	48.58	0.0286	48.96
140%d	0.0157	38.94	0.0489	38.92	0.0267	39.06
130%d	0.0146	29.20	0.0455	29.26	0.0248	29.17
120%d	0.0135	19.45	0.0421	19.60	0.0229	19.27
110%d	0.0124	9.73	0.0386	9.66	0.0210	9.38
100%d	0.0113	-	0.0352	-	0.0192	-
90%d	0.0102	-9.73	0.0317	-9.94	0.0173	-9.90
80%d	0.0090	-20.35	0.0282	-19.87	0.0154	-19.79
70%d	0.0079	-30.09	0.0247	-29.83	0.0134	-30.21
60%d	0.0068	-39.82	0.0212	-39.77	0.0115	-40.10
50%d	0.0057	-49.56	0.0177	-49.72	0.0096	-50.00

See the simulation result in table 5.3 and 5.4, we can find the relationship between the pertange change value of oradinary value (water volume and drag out) and the pertange change value of concentration of cleaning agent at twenty cycle time of rinsing in the last tank as shown in figure 5.19 and 5.20.

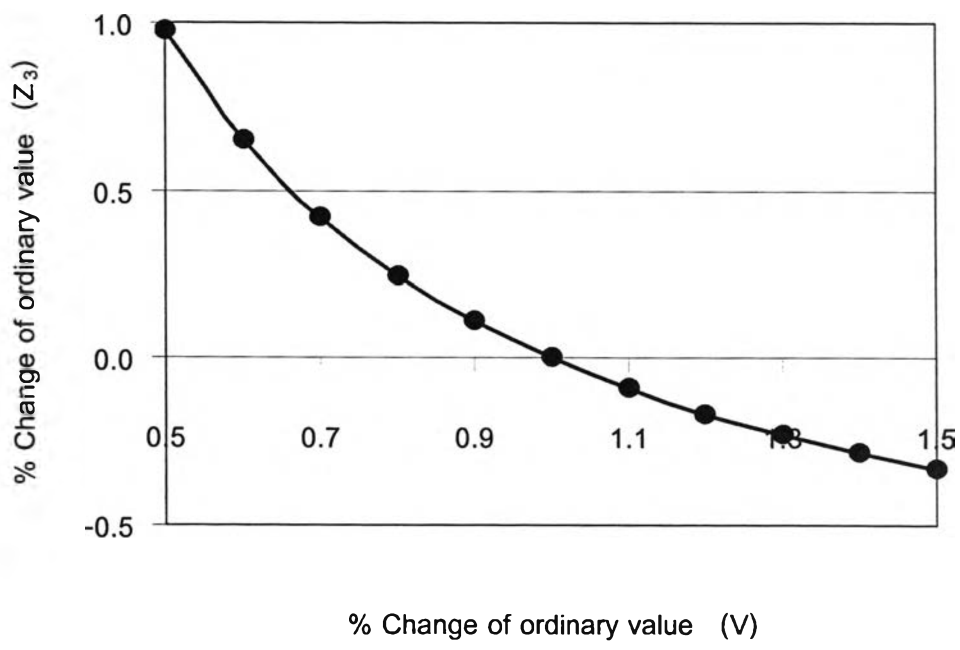

Figure 5.19 % Change of concentration in last stage (Z_3) at various of change of rinse water volume

From figure 5.19, the relationship between the percentange change value of oradinary water volume and the pertange change value of concentration of cleaning agent is nonlinear. Decreased less than 80 percentage of ordinary volume, the change of concentration of cleaning agent is more than one time of water volume change, however the concentration has less change when we increase over 120 percentage of ordinary volume.

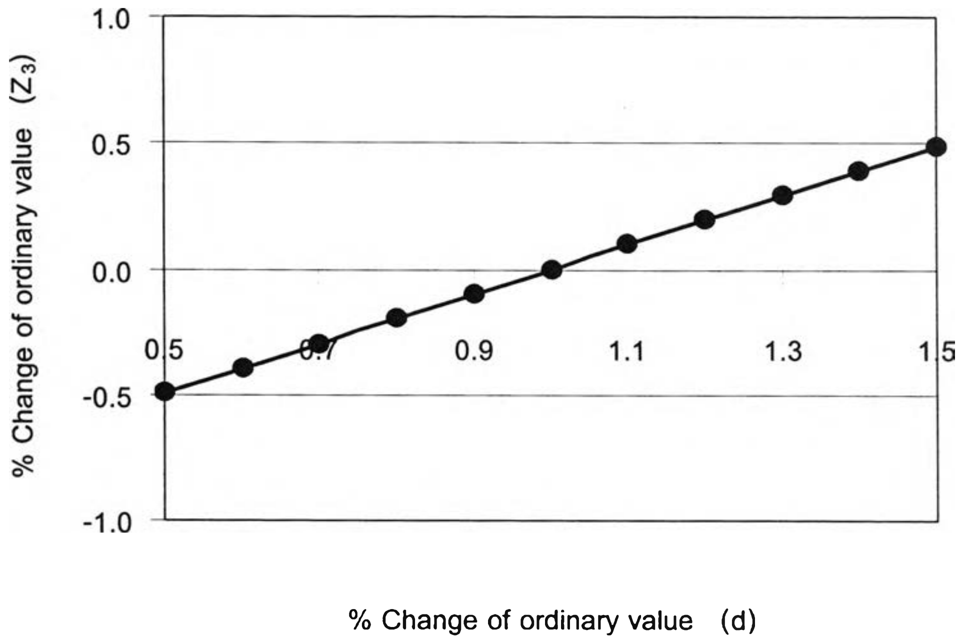

Figure 5.20 % Change of concentration in last stage (Z_3) at various of change of drag out volume

From figure 5.20, the relationship between the percentange change value of oradinary drag out volume and the pertange change value of concentration of cleaning agent is linear.

In the conclusion, water volume in rising tank has more effect than drag out volume for the concentration of cleaning agent in the last tank at cycle time of rinsing. Especially the water volume in each tank is decreased.

5.2 Optimization

In this research, we study two cases of optimization the following.

Case 1 Determine the optimum volume of rinse water

From optimization problem in the section 4.4, we apply constraint and express the problem as following.

$$\min_{V} C_3 = a_2C_2 - (1-a_2)Z_2 \tag{5.19}$$

$$\textit{Subject to} \quad V\frac{d}{dt}Z_1 = (D - a_1D)C_0 - (1-a_1)DZ_1 \tag{5.20}$$

$$V\frac{d}{dt}Z_2 = (D - a_2D)C_1 - (1-a_2)DZ_2 \tag{5.21}$$

$$V\frac{d}{dt}Z_3 = (D - a_3D)C_2 - (1-a_3)DZ_3 \tag{5.22}$$

$$0 \le Z_3 \tag{5.23}$$

$$Z_3 = Z_3(t_N) \tag{5.24}$$

$$0 \le V \le 50 \tag{5.25}$$

When we determine the cleaning agent concentration in the last tank at final of cycle time $Z_3(t_N)$, this problem can be sloved by using optimization toolbox. The optimization result indicate the dynamic respond of concentration and the optimum volume of rinse water as listed in table 5.7.

Table 5.7 Optimum volume of rinse water for various rinsing times.

Rinsing time (sec.)	Limitation value of Z_3 (g/l)	Optimum volume of rinse water (litre)	Error (%)
5	0.0105	19.55	-2.25
10	0.0089	19.58	-2.10

Rinsing time (sec.)	Limitation value of Z_3 (g/l)	Optimum volume of rinse water (litre)	Error (%)
15	0.0312	19.58	-2.10
20	0.0126	19.70	-1.50
25	0.0359	19.57	-2.15
30	0.0195	19.69	-1.55

From data on table 5.7, the value of water volume is near the value in table 5.1 (20 litres) which the error between actual value and calculated value is about 1.50%-2.25%. Then we increase the drag out volume (50 to 150 percentage of the ordinary value) and find the optimum volume of rinser under the same value of allowable concentration of cleaning agent in the last tank as shown in table 5.8 to 5.9.

Table 5.8 Optimum volume of rinse water for various of drag out volume.

Drag out volume	Optimum volume of rinse water (litre)					
	Rinse time 5 sec.		Rinse time 10 sec.		Rinse time 15 sec.	
	V	% Diff	V	% Diff	V	% Diff
150%d	29.325	50.00	29.368	49.99	29.369	49.99
140%d	27.370	40.00	27.411	39.99	27.411	39.99
130%d	25.415	30.00	25.453	29.99	25.453	29.99
120%d	23.460	20.00	23.495	19.99	23.495	19.99
110%d	21.505	10.00	21.537	9.99	21.537	9.99
100%d	19.550	-	19.580	-	19.580	-
90%d	17.595	-10.00	17.621	-10.01	17.621	-10.01
80%d	15.640	-20.00	15.663	-20.01	15.663	-20.01
70%d	13.685	-30.00	13.705	-30.01	13.706	-30.00
60%d	11.730	-40.00	11.747	-40.01	11.748	-40.00
50%d	9.775	-50.00	9.790	-50.00	9.790	-50.00

Table 5.9 Optimum volume of rinse water for various of drag out volume (Continued).

Drag out volume	Optimum volume of rinse water (litre)					
	Rinse time 20 sec.		Rinse time 25 sec.		Rinse time 30 sec.	
	V	% Diff	V	% Diff	V	% Diff
150%d	29.547	49.98	29.357	50.01	29.540	50.02
140%d	27.577	39.98	27.400	40.01	27.571	40.03
130%d	25.608	29.99	25.443	30.01	25.602	30.03
120%d	23.638	19.99	23.486	20.01	23.632	20.02
110%d	21.668	9.99	21.528	10.01	21.663	10.02
100%d	19.700	-	19.570	-	19.690	-
90%d	17.728	-10.01	17.614	-9.99	17.724	-9.98
80%d	15.759	-20.01	15.657	-19.99	15.755	-19.98
70%d	13.789	-30.01	13.700	-29.99	13.785	-29.99
60%d	11.819	-40.01	11.743	-39.99	11.816	-39.99
50%d	9.849	-50.01	9.786	-49.99	9.847	-49.99

From the optimization result, we consider the feasiblity of change drag out volume and the result under the experimental result and practical improvement in the factory. The feasible area and the optimization result are shown in figure 5.21.

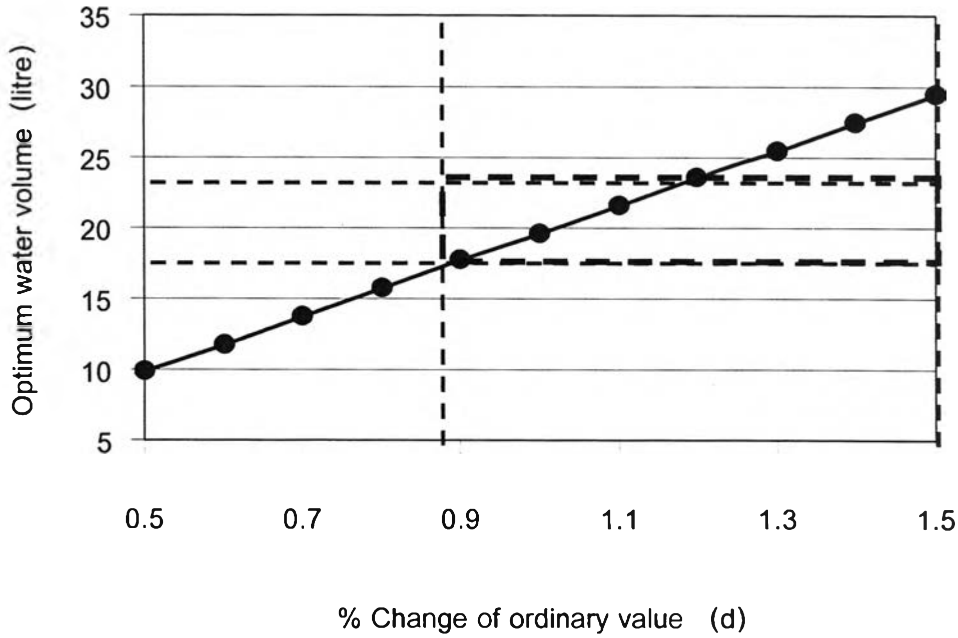

Figure 5.21 Feasible area of drag out volume change and optimal volume of water

The optimum volume of rinse water in each tank directly varies with drag out volume and the same proportion. Considering the feasible area of drag out volume change, we find that decreased drag out volume effects to the process time. If we requires 10 percentage decreased of ordinary value, we must to hold the container with three time increased of holding time in each tank. Large process time for decreasing drag out volume is not appropiate for implementation, so change of drag out is not smaller than 90 percentage of ordinary volume. Considering the optimization result, if the optmum volume is over 25 litres, then the water overflows from the rinsing tank. The optimum volume is less than 17 litres at (120 percentage of ordinary value), then the water does not submerge the container. The feasible area of drag out volume change is between 90 to 120 percentage of ordinary volume and this area can provide the optimal volume for practical improvement.

Case 2 Determine drag out volume

From optimization problem in the section 4.4, we apply constraint and express the problem as following.

$$\min_{d} C_3 = a_2C_2 - (1-a_2)Z_2 \quad (5.26)$$

$$Subject\ to \quad V\frac{d}{dt}Z_1 = (D - a_1D)C_0 - (1-a_1)DZ_1 \quad (5.27)$$

$$V\frac{d}{dt}Z_2 = (D - a_2D)C_1 - (1-a_2)DZ_2 \quad (5.28)$$

$$V\frac{d}{dt}Z_3 = (D - a_3D)C_2 - (1-a_3)DZ_3 \quad (5.29)$$

$$0 \le Z_3 \quad (5.30)$$

$$Z_3 = Z_3(t_N) \quad (5.31)$$

$$0 \le d \le 2 \quad (5.32)$$

When we determine the cleaning agent concentration in the last tank at final of cycle time $Z_3(t_N)$, this problem can be sloved by using optimization toolbox. The optimization result indicate the dynamic respond of concentration and the optimum drag out volume as listed in table 5.10.

Table 5.10 Optimum volume of drag out for various rinsing times.

Rinsing time (sec.)	Limitation value of Z_3 (g/l)	Optimum volume of drag out (litre)	Error (%)
5	0.0105	0.7161	2.30
10	0.0089	0.7151	2.16
15	0.0312	0.7150	2.14
20	0.0126	0.7107	1.53
25	0.0359	0.7153	2.19
30	0.0195	0.7109	1.56

From data on table 5.10, the value of drag out volume is near the value in table 5.1 which the error between actual value and calculated value is about 1.53%-2.30%. Then we increase the rinse water volume (50 to 150 percentage of the ordinary value) and find the optimum volume of drag out, which is shown as Table 5.11 to 5.12.

Table 5.11 Optimum volume of drag out for various of rinse water volume.

Drag out volume	Optimum volume of drag out (litre)					
	Rinse time 5 sec.		Rinse time 10 sec.		Rinse time 15 sec.	
	d	% Diff	d	% Diff	d	% Diff
150%V	1.0742	50.01	1.0726	49.99	1.0726	50.01
140%V	1.0026	40.01	1.0011	39.99	1.0011	40.01
130%V	0.9309	30.00	0.9296	30.00	0.9296	30.01
120%V	0.8593	20.00	0.8581	20.00	0.8581	20.01
110%V	0.7877	10.00	0.7866	10.00	0.7865	10.00
100%V	0.7161	-	0.7151	-	0.7150	-
90%V	0.6445	-10.00	0.6436	-10.00	0.6435	-10.00
80%V	0.5729	-20.00	0.5720	-20.01	0.5720	-20.00
70%V	0.5013	-30.00	0.5005	-30.01	0.5005	-30.00
60%V	0.4297	-39.99	0.4290	-40.01	0.4290	-40.00
50%V	0.3581	-49.99	0.3575	-50.01	0.3575	-50.00

Table 5.12 Optimum volume of drag out for various of rinse water volume (Continued).

Drag out volume	Optimum volume of drag out (litre)					
	Rinse time 20 sec.		Rinse time 25 sec.		Rinse time 30 sec.	
	d	% Diff	d	% Diff	d	% Diff
150%V	1.0661	50.01	1.0730	50.01	1.0663	49.99
140%V	0.9950	40.00	1.0015	40.01	0.9953	40.01
130%V	0.9239	30.00	0.9299	30.00	0.9242	30.00
120%V	0.8529	20.01	0.8584	20.01	0.8531	20.00
110%V	0.7818	10.00	0.7869	10.01	0.7820	10.00

Drag out volume	Optimum volume of drag out (litre)					
	Rinse time 20 sec.		Rinse time 25 sec.		Rinse time 30 sec.	
	d	% Diff	d	% Diff	d	% Diff
100%V	0.7107	-	0.7153	-	0.7109	-
90%V	0.6397	-9.99	0.6438	-10.00	0.6398	-10.00
80%V	0.5686	-19.99	0.5723	-19.99	0.5687	-20.00
70%V	0.4975	-30.00	0.5007	-30.00	0.4976	-30.00
60%V	0.4264	-40.00	0.4292	-40.00	0.4265	-40.01
50%V	0.3554	-49.99	0.3577	-49.99	0.3555	-49.99

From the optimization result, we consider the feasiblity of change water volume under the experimental result and practical improvement in the factory. The feasible area and the optimization result are shown in figure 5.22.

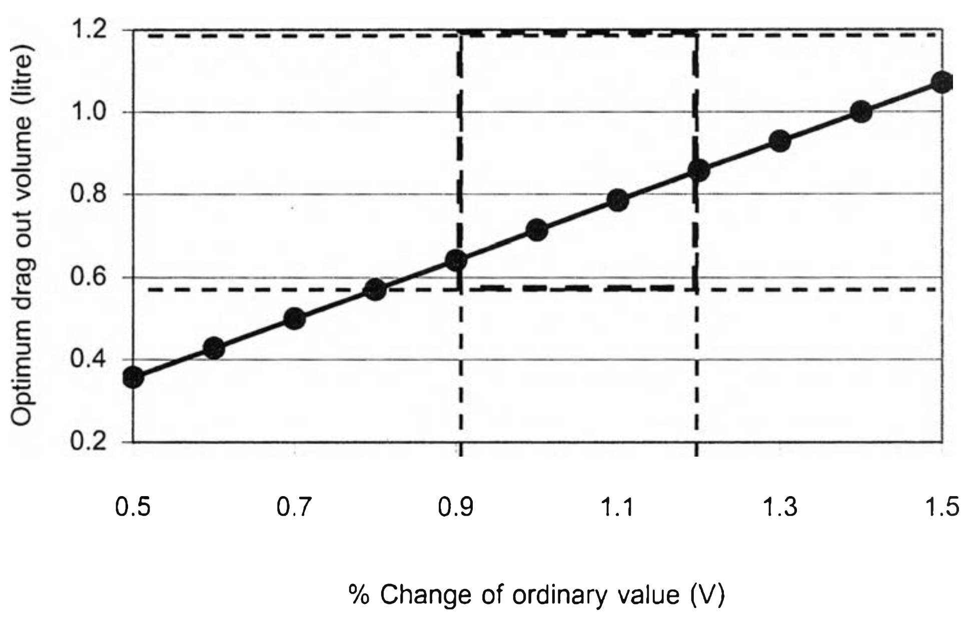

Figure 5.22 Feasible area of water volume change and optimal volume of drag out

The optimum volume of drag out directly varies with water volume and the same proportion. Considering the feasible area of water volume change, we find that decreased water volume in each tank effects to the rinsing process. If we requires 10 percentage decreased of ordinary value, the water overflows from the rinsing tank. While we increase with 20 percentage of ordinary value, the water does not submerge the container. From above reason, the factory can not operate rinsing process. Considering the optimization result, if the optmum volume is less than 0.65 litres, the factory must increase process time of rinsing process. The feasible area of water volume change is between 90 to 120 percentage of ordinary volume and this area can provide the optimal volume for practical improvement.