CHAPTER VI

RECOMMENDED DESIGN PROCEDURE FOR CONTACT STABILIZATION PROCESS

6.1 Introduction

In this research work, a main parameter which has been found in the operation of contact stabilization process is sludge age (θ_c). It is also the most importance parameter in design calculation of a contact stabilization treatment plant.

The applications of contact stabilization process for industrial waste treatment has not been adequate kinetic coefficients yet. Therefore the feasibility study using a laboratory scale contact stabilization unit is recommended. The operating conditions and various essential parameters should be determined.

However, the design procedure of a contact stabilization treatment plant should be carefully attended for the optimum conditions and design parameters, as stated by ORHON (1977), "The contact stabilization is a complicated process and its design has been more an art than a science".

The recommended design parameters of the process are shown in Table 6.1.

Table 6.1 - Recommended Design Parameters of Contact Stabilization Process

Parameters	Notations	Units	Values
Sludge age	θ_c	day	5-20
Specific substrate Utilization rate	U_T	$\frac{\text{kg COD}}{\text{kg VSS-day}}$	0.2-0.8
Concentration of MLSS in contact tank	X_C	mg/ℓ	1,500-6,000
Concentration of MLSS in stabilization tank	X_S	mg/ℓ	3,000-12,000
Contact time	t_C	hr	1-4*
Stabilization time	t_S	hr	2-10*
Fraction of biomass in the contact tank	α	%	5-25
Recycle ratio	R	%	50-200

*depending on strength of wastewater

6.2 Design Procedure

The design procedure of contact stabilization process within carbonaceous phase is recommended as following:

1. Evaluate the kinetic coefficients: a, a_1^*, a_2^*, a_1, a_2, a_3, a_4, k_2, $(K_o)_{TT}$, $(K_o)_{CT}$, γ_{TT} and γ_{CT} using laboratory scale contact stabilization unit.

2. Given values of: Q, x_i and x_e ($\simeq x_c$). Then, select θ_c, t_C and R from Table 6.1.

3. Calculate C_{TT} from equation (3.56).

$$C_{TT} = \frac{\gamma_{TT}(1 + k_2\theta_c)}{\theta_c\{a(K_o)_T - k_2)\} - 1} \qquad (6.1)$$

4. Calculate M_{TT} from equation (3.25)

$$M_T = \frac{Qx_i}{C_{TT}} \qquad (6.2)$$

5. Calculate U_{TT} from equation (3.17)

$$U_{TT} = \frac{1 + k_2\theta_c}{a\theta_c} \qquad (6.3)$$

6. Calculate η_{TT} from equation (3.39)

$$\eta_{TT} = \frac{U_{TT}}{C_{TT}} \qquad (6.4)$$

7. Calculate x_e from equation (3.22)

$$x_e = (1 - \eta_{TT})x_i \qquad (6.5)$$

8. If x_e is not within desired value, modify θ_c and repeat step 1 to 7. If x_e is satisfactory, continue.

9. Calculate η_{CT} from equation (5.14)

$$\eta_{CT} = 1 - a_1 a_1^* \theta_c^{a_2+a_2^*} (1 - \eta_{TT})(1 + R) \qquad (6.6)$$

10. Calculate C_{CT} from equation (3.47)

$$C_{CT} = \frac{(K_o)_{CT} - \gamma_{CT}\eta_{CT}}{\eta_{CT}} \qquad (6.7)$$

11. Calculate α from equation (5.10)

$$\alpha = \frac{1}{a_1\ \theta_c^{a_2}.\ C_{CT}} \qquad (6.8)$$

12. Calculate M_C from equation (3.28)

$$M_C = \alpha M_T \tag{6.9}$$

13. Calculate X_C and V_C from equation (3.28) and (3.33)

$$X_C = \frac{M_C}{Qt_C} \tag{6.10}$$

$$V_C = Qt_C \tag{6.11}$$

If X_C is not satisfactory, modify tc, if X_C is satisfactory, continue.

14. Calculate M_S, if the fraction of biomass in the sedimentation tank is negligible when compare to M_T:

$$M_S = M_T - M_C \tag{6.12}$$

15. Calculate U_S from equation (5.19)

$$U_S = a_3\theta_c^{a_4} \tag{6.13}$$

16. Calculate x_S from equation (5.17)

$$x_S = \frac{x_C RQ - U_S M_S}{RQ} \tag{6.14}$$

17. Calculate U_{CT} from equation (3.41)

$$U_{CT} = \frac{Q\left\{x_i + Rx_S - (1 + R)x_C\right\}}{M_C} \tag{6.15}$$

18. Calculate k_C from equation (5.8), a_C and $(k_2)_C$ from Table 5.9.

$$k_C = a_C U_{CT} - (k_2)_C \tag{6.16}$$

19. Calculate X_S from equation (3.4)

$$X_S = \frac{X_C \left\{(1 + R) - k_C t_C\right\}}{R} \qquad (6.17)$$

If the term $k_C t_C$ is negligible when compare to the term $(1 + R)$

$$X_S = \frac{(1 + R)X_C}{R} \qquad (6.18)$$

20. Calculate V_S and t_S from equation (3.29) and (3.35):

$$V_S = \frac{M_S}{X_S} \qquad (6.19)$$

$$t_S = \frac{V_S}{Q} \qquad (6.20)$$