CHAPTER IV

RESULTS AND DISCUSSION

4.1 Compost characteristics

Before pH adjustment, pH of the compost was quite high (8-10) because the composted material (grass clipping) was green. Green materials have high nitrogen that causes high pH in composting process (Krzymien, 1999). In the first trial, mushrooms were found in the composters (Figure 4.1) on the 7th day of composting; therefore, a new trial was attempted. Before the second trial, the grass clippings were washed more carefully. However, mushroom still grew in the composters. They were removed by manual picking. During the third week of composting, they decreased and disappeared at the end of the fourth week.

Figure 4.1 Mushroom in one of the composters.

4.1.1 Volume Reduction

The initial mass and volume of grass in each composter were 300 g and 2978 cm^3, respectively. After 63 days of composting, grass clippings, as shown in Figure 4.2, was brown and looked like humus. Furthermore, both its mass and volume decreased. Figure 4.3 shows the average volume reduction percentage of grass after composting at different pHs and moisture contents. The average volume reduction percentages were from the duplicated tests, which were less than 20% different in term of the results in all cases. Tchobanoglous et al. (1993) reported that the proper moisture content and pH in composting are 50 to 60% and 7 to 7.5, respectively, because they are proper to microorganisms. From Figure 4.3, the grass composted at 30% MC and initial pH 7 has the maximum volume reduction percentage (95.3%).

Figure 4.2 Grass compost after 63 days.

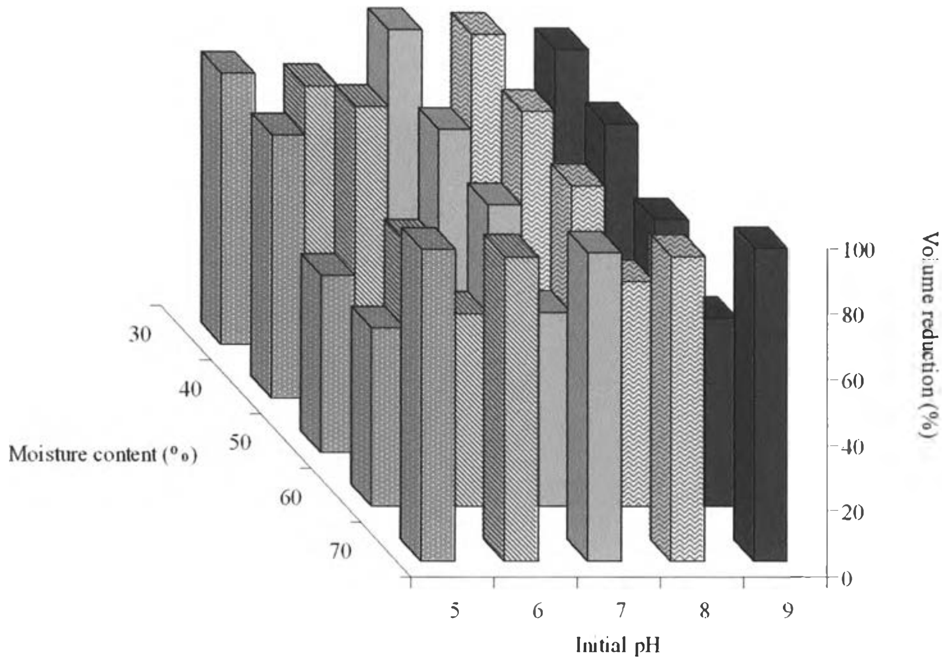

Figure 4.3 Volume reduction percentages of grass clippings after composting at different pHs and MCs.

Tchobanoglous et al. (1993) and Liang et al. (2003) suggested that 50% moisture content seems to be the minimal requirement for rapid increase in microbial activity, while a range of 60-70% provided maximum activities. In the range of 30-60% moisture content, the higher the moisture content, the higher the microbial activities. Figure 4.3 shows the results that partially disagree with Tchobanoglous et al. (1993) and Liang et al. (2003); the moisture contents of 50 and 60% provided the lowest volume reduction at all pH tested while pH between 7 and 8 was optimal for volume reduction. To achieve high volume reduction of the grass compost, the moisture content has to be either low (30- 40%) or high (70%). Nelson et al. (2003) investigated the effects of moisture content on the final composted product of feedlot manure and found that the 40 and 50% MC provided low volume reduction but significant mass reduction compared to the 60 and 70%. pH tended to have lesser effect on the volume reduction at the optimal moisture contents; moisture content is more important or controlling than pH. At the most proper moisture (70%), pH had almost no effect on the volume reduction. pH became important at the unsuitable moisture contents (50- 60%) and the maximum volume reduction occurred at neutral pH.

4.1.2 Cation Exchange Capacity

Figure 4.4 shows the CEC of the non-composted grass (control) and the grass compost at different pHs and MCs and. The control has lower CEC than the grass compost. The MC between 40 and 70% had very limited effects on the CEC of the compost. The compost had distinctively higher CEC when the MC was 30%. Except at 40% MC, pH 8 offered slightly more or approximately same CEC than the other pHs. CEC tended to increase slightly with increasing pH between 5 to 8. At pH 9, CEC dropped inconsiderably.

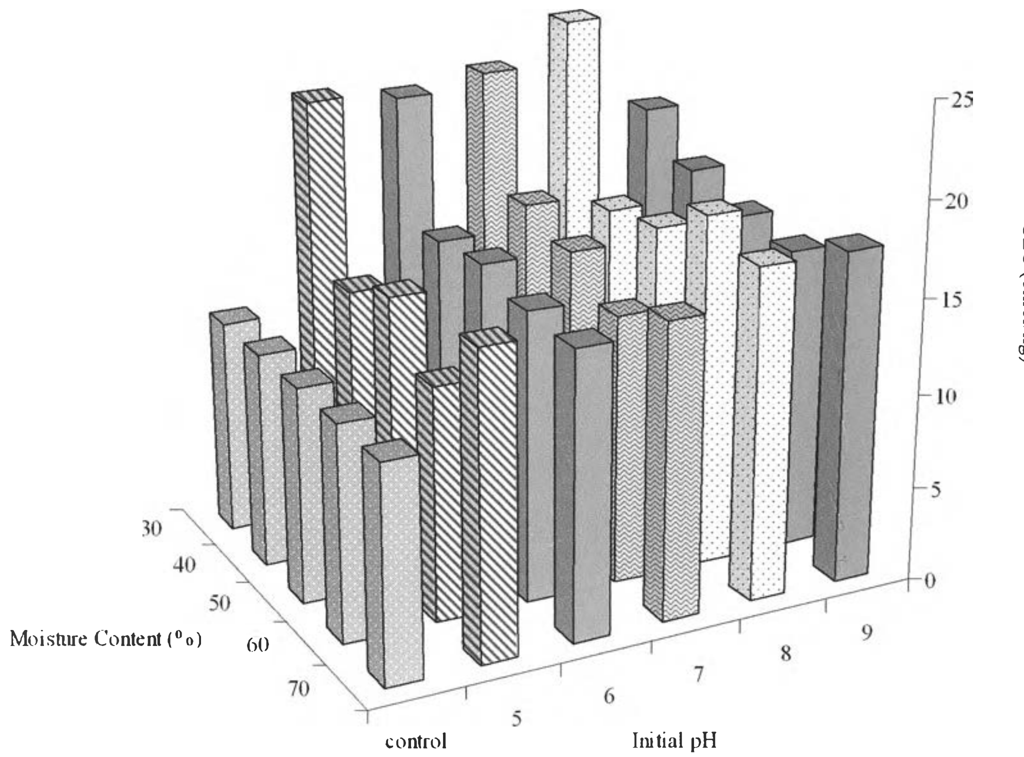

Figure 4.4 Cation exchange capacities of the control and grass clipping after composting at different pHs and MCs.

4.2 The Adsorption Isotherm Test

4.2.1 Equilibrium Time

The batch adsorption test results showed that the equilibrium time of grass clippings and all composts (25 types) was between 3 to 5 hours (Table 4.1). Therefore, 5 hours was used to be the equilibrium time for adsorptive capacity determination.

Table 4.1 The equilibrium time of all composts (25 types)

Composting condition (% MC/initial pH)	Equilibrium time (hours)			
	Cd	Cu	Pb	Zn
Non-composted grass	5	5	3	5
30/5	3	3	3	3
30/6	3	3	3	3
30/7	3	3	3	3
30/8	5	5	3	3
30/9	3	3	3	3
40/5	5	3	3	3
40/6	3	3	5	3
40/7	3	3	3	3
40/8	3	3	3	3
40/9	3	3	3	3
50/5	3	3	3	3
50/6	3	5	3	3
50/7	3	3	3	3
50/8	3	3	3	3
50/9	3	3	3	3

Table 4.1 The equilibrium time of all composts (25 types) (Cont.)

Composting condition (% MC/initial pH)	Equilibrium time (hours)			
	Cd	Cu	Pb	Zn
60/5	3	3	3	3
60/6	3	5	3	3
60/7	3	3	5	3
60/8	5	3	3	3
60/9	3	3	3	3
70/5	3	3	3	3
70/6	3	3	5	3
70/7	5	3	3	3
70/8	3	3	3	3
70/9	3	3	3	3

4.2.2 Metal Adsorption Performances

Based on the Freundlich model, K_f is sometimes used as a surrogate of the adsorption capacity while the strength of the sorbate-sorbent interaction is described relatively by n. Larger K_f values imply a greater sorbent capacity, while smaller n values signify a stronger interaction. Table 4.2 shows the determination coefficient (r^2) of the Freundlich model fitting of the isotherm data. High r^2 (> 0.89) indicated that the data can be well represented by the Freundlich expression.

Table 4.3 shows that for each compost the strengths of the sorbate-sorbent interaction of different metals varied. For the same compost, Cd has the smallest n value, so that Cd has the strongest sorbate-sorbent interaction. The interaction strength of these metals to grass clippings compost is found to be in the order Cd > Zn > Pb > Cu. Beckwith (1959) stated that many metals formed to be metal complexes with humic substances and the order of stabilities of the different metal complexes followed that of the Irving-Williams series: $Pb^{2+} > Cu^{2+} > Ni^{2+} > Co^{2+} > Zn^{2-} > Cd^{2+} > Fe^{2+} > Mn^{2+} > Mg^{2+}$. Thus, humic substances might not be the major component of the compost from this study as the interaction strength of these metals to non-composted grass was in the following order: Cd > Pb > Zn > Cu.

Table 4.2 The determination coefficient from the Freundlich model

Composting condition (% MC/initial pH)	Determination coefficient			
	Cd	Cu	Cd	Zn
non-composted grass	0.9488	0.9938	0.8944	0.9746
30/5	0.9652	0.9741	0.9911	0.9755
30/6	0.9643	0.9944	0.9529	0.9780
30/7	0.9681	0.9868	0.9884	0.9651
30/8	0.9626	0.9829	0.9738	0.9533
30/9	0.9636	0.9722	0.9827	0.9714
40/5	0.9516	0.9646	0.9585	0.9896
40/6	0.9517	0.9636	0.9778	0.9873
40/7	0.9509	0.9593	0.9555	0.9903
40/8	0.9725	0.9842	0.9777	0.9897
40/9	0.9807	0.9888	0.9758	0.9681
50/5	0.9714	0.9641	0.9586	0.9878
50/6	0.9715	0.9882	0.9661	0.9667
50/7	0.9802	0.9832	0.9775	0.9921
50/8	0.9614	0.9773	0.9745	0.9918
50/9	0.9753	0.9774	0.9563	0.9508
60/5	0.9712	0.9749	0.9854	0.9920
60/6	0.9662	0.9632	0.9523	0.9916
60/7	0.9675	0.9778	0.9538	0.9910
60/8	0.9804	0.9717	0.9812	0.9900
60/9	0.9916	0.9659	0.9602	0.9829
70/5	0.9744	0.9532	0.9576	0.9968
70/6	0.9583	0.9725	0.9740	0.9942
70/7	0.9558	0.9614	0.9607	0.9971
70/8	0.9788	0.9658	0.9752	0.9504
70/9	0.9776	0.9638	0.9512	0.9666

Table 4.3 n values from the Freundlich model

Composting condition (% MC/initial pH)	n values			
	Cd	Cu	Pb	Zn
non-composted grass	1.04	9.38	2.65	3.85
30/5	0.50	1.98	0.64	0.67
30/6	0.49	2.33	0.62	0.64
30/7	0.55	1.98	1.07	0.68
30/8	0.60	2.06	0.72	0.72
30/9	0.54	1.85	0.83	0.71
40/5	0.45	1.08	1.07	0.81
40/6	0.37	0.98	1.20	0.54
40/7	0.42	1.42	1.25	0.60
40/8	0.54	1.50	1.98	0.72
40/9	0.67	1.54	0.89	0.84
50/5	0.45	1.10	0.68	0.57
50/6	0.45	1.69	1.04	0.54
50/7	0.45	1.28	1.49	0.55
50/8	0.44	1.25	1.15	0.57
50/9	0.85	5.06	1.00	0.91
60/5	0.46	0.91	1.69	0.56
60/6	0.43	1.08	1.65	0.55
60/7	0.46	1.19	1.23	0.58
60/8	0.57	1.37	0.87	0.52
60/9	1.16	0.61	2.02	1.17
70/5	0.47	0.93	1.73	0.46
70/6	0.45	1.27	1.31	0.46
70/7	0.46	1.44	1.18	0.53
70/8	0.89	1.30	1.18	0.96
70/9	0.82	2.21	0.97	0.93

4.2.2.1 Cadmium Adsorption Performances

The results in Figure 4.5, which shows K_f of cadmium adsorption of the control and grass clipping after composting at different pHs and MCs, are similar to the results of CEC in Figure 4.4 and agree with the study of Pereira and Arruda (2003) which investigated cadmium adsorption on vermicompost. They found that higher CEC values of vermicompost correspond to a higher capacity to sorb metals. It is clear that the 30% MC provided the compost that had substantially higher K_f. The 30% MC did not only provide high CEC values and K_f, but also gave high volume reduction percentage (Figure 4.3). Among the others MCs, which resulted in the composts with comparable K_f, the MC of 40% was the most optimal. Initial pH did not dramatically affect K_f, which tended to increase with pH. The Cd removal percentages shown in Figure 4.6 generally agree with the K_f results; 30%MC and/or pH 9 are favorable conditions for Cd removal.

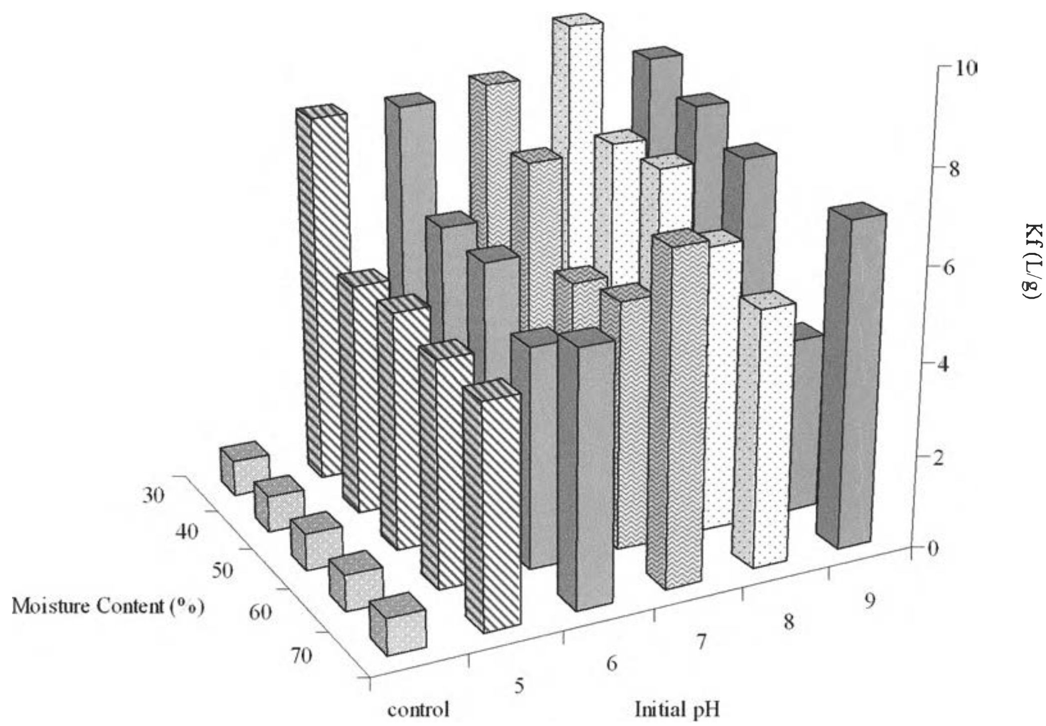

Figure 4.5 Freundlich coefficients (K_f) of cadmium sorption of the control and grass clipping after composting at different pHs and MCs.

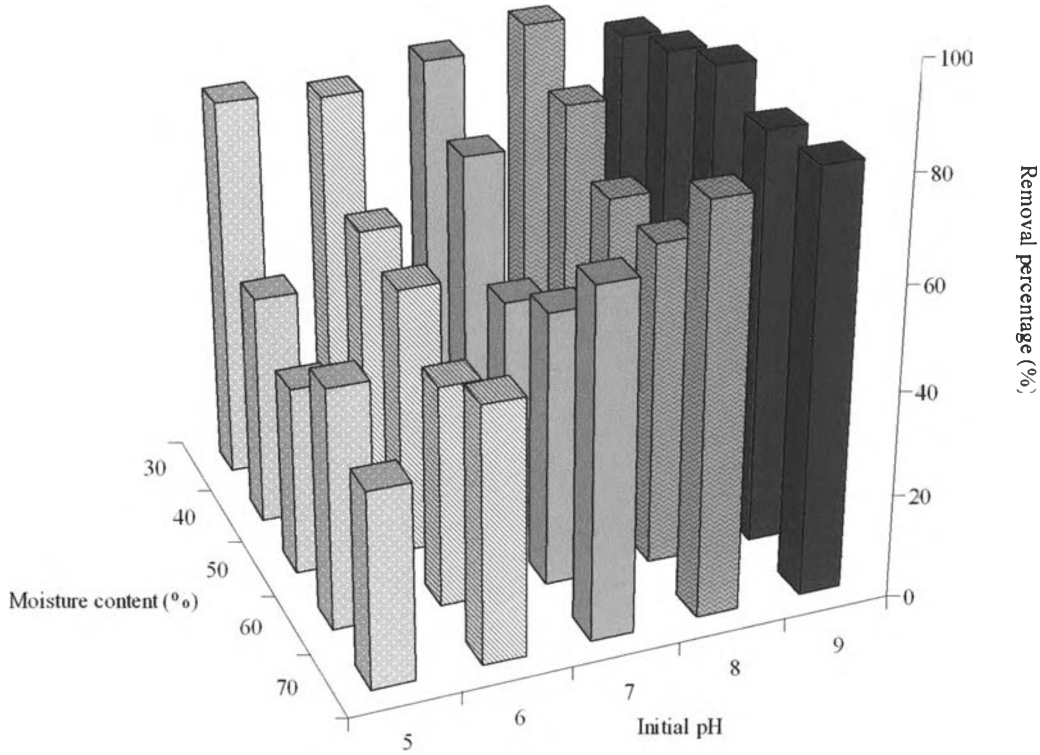

Figure 4.6 Cadmium removal percentage of grass clippings after composting at different pHs and MCs.

Removal percentages shown in Figure 4.6 were calculated from the highest metal concentration used in test (15 ppm). Table 4.4 shows the range of Cd removal percentages at the minimum (0.7 ppm) and maximum (15 ppm) concentrations used in the isotherm tests. The low removal percentages were from the maximum concentration while the high ones were from the minimum concentration. In the control test, the Cd concentration was 10.5 ppm and the mass of non-composted grass was varied between 0.01 and 0.20 g. The Cd removal percentages at the maximum and minimum mass were 80.18 and 25.37%, respectively. At 0.02 g of the control sorbent, the same mass used in the adsorption tests for the compost, Cd removal was 39.58%, much lower than most of the values in Table 4.4.

Table 4.4 The cadmium removal percentages at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	Removal percentage range (%)
30/5	74.29 – 83.75
30/6	72.48 – 87.60
30/7	84.97 – 86.60
30/8	80.66 – 83.95
30/9	75.64 – 86.38
40/5	44.49 – 81.11
40/6	54.25 – 86.48
40/7	65.40 - 81.7
40/8	72.20 – 86.19
40/9	79.72 – 82.56
50/5	36.28 – 78.63
50/6	51.64 – 85.71
50/7	45.61 – 83.03
50/8	62.10 – 85.32
50/9	84.10 – 85.86
60/5	46.26 – 81.58
60/6	42.59 – 82.44
60/7	52.61 – 84.37
60/8	62.12 – 78.00
60/9	79.53 – 81.12
70/5	37.51 – 82.26
70/6	49.03 – 87.05
70/7	66.70 – 87.23
70/8	78.29 – 84.94
70/9	80.98 – 85.79

Figure 4.7 presents q or mg sorbate/g sorbent at the maximum Cd concentration used in the isotherm test. Similar trends as the removal percentages were observed. The initial pH 9 and 30% MC provided high Cd adsorptive capacities. Table 4.5 presents the range of q at the minimum and maximum concentrations used in the isotherm test. The minimum concentration solution resulted in the low q, which were not much different. The q of the control at the minimum, 0.02 g, and maximum mass was 6.68, 5.21, and 1.05 mg Cd/g grass, respectively. These values are much less than the q of the compost at the maximum Cd concentration (Table 4.5).

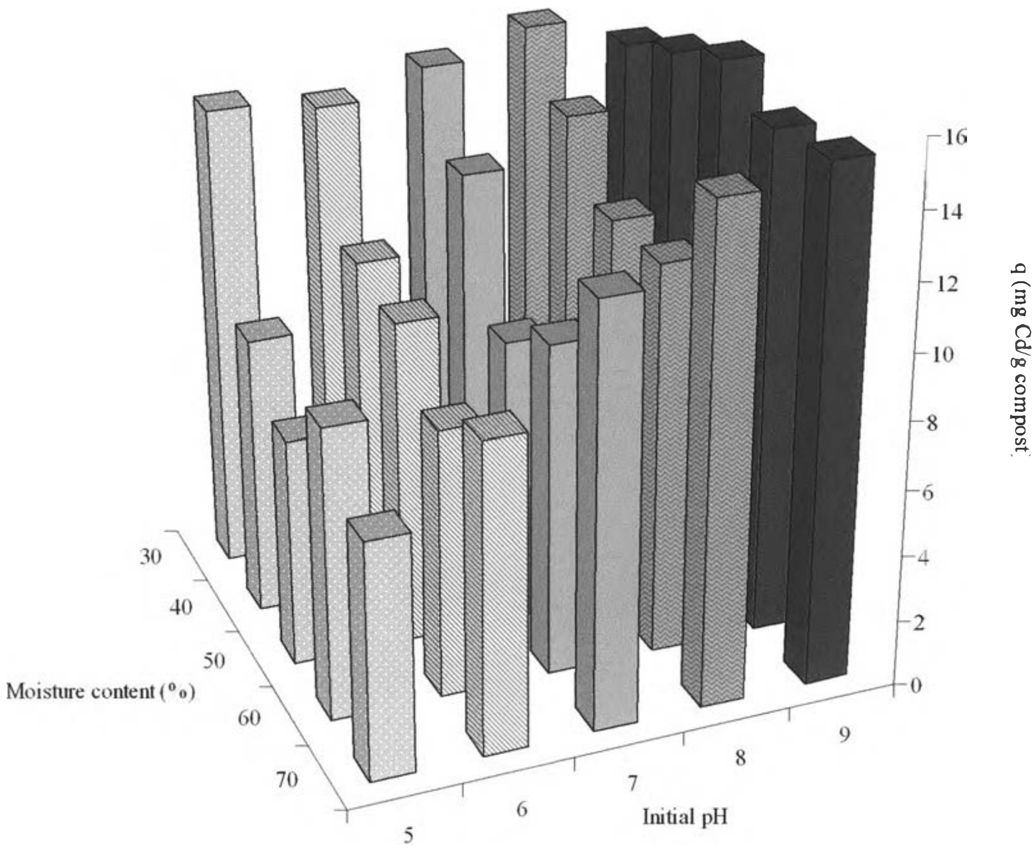

Figure 4.7 Cadmium adsorptive capacities (q) of grass clippings after composting at different pHs and MCs.

Table 4.5 The cadmium adsorptive capacity (q) at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	q (mg Cd/g compost)
30/5	0.81- 14.03
30/6	0.84 - 13.69
30/7	0.82 - 14.47
30/8	0.81 - 15.24
30/9	0.83 - 14.29
40/5	0.78 - 8.41
40/6	0.83 - 10.25
40/7	0.79 - 12.36
40/8	0.83 - 13.64
40/9	0.79 - 15.06
50/5	0.76 - 6.85
50/6	0.82 - 9.76
50/7	0.80 - 8.62
50/8	0.82 - 11.73
50/9	0.76 - 15.89
60/5	0.79 - 8.74
60/6	0.79 - 8.05
60/7	0.81 - 9.94
60/8	0.75 - 11.74
60/9	0.68 - 15.03
70/5	0.79 - 7.09
70/6	0.84 - 9.26
70/7	0.84 - 12.60
70/8	0.72 - 14.79
70/9	0.72 - 15.30

4.2.2.2 Copper Adsorption Performances

Figure 4.8 shows K_f of copper adsorption of the control and grass clipping after composting at different pHs and MCs. Non-composted grass clippings had extremely low K_f, close to 0 L/g. Initial pH 6 resulted in compost with high K_f for Cu sorption. Above pH 6, K_f tended to be lower as initial pH increased. At initial pH 5 to 8, K_f was high between 40 and 60% MC and highest at 50% MC. On the other hand, at initial pH 9, K_f was low at 40 and 60% MC and lowest at 50% MC. K_f was affected by both initial pH and moisture content in composting process. The removal percentages in Figure 4.9, which were determined at the highest Cu concentration (6.7 ppm) used in the isotherm test, do not agree well with K_f values in Figure 4.8. All composts, provided high and similar removal percentages, even the initial pH 9. The results shown in Figure 4.9 are similar to the results on CEC in Figure 4.4; the low pH and low MC tended to be more favorable conditions.

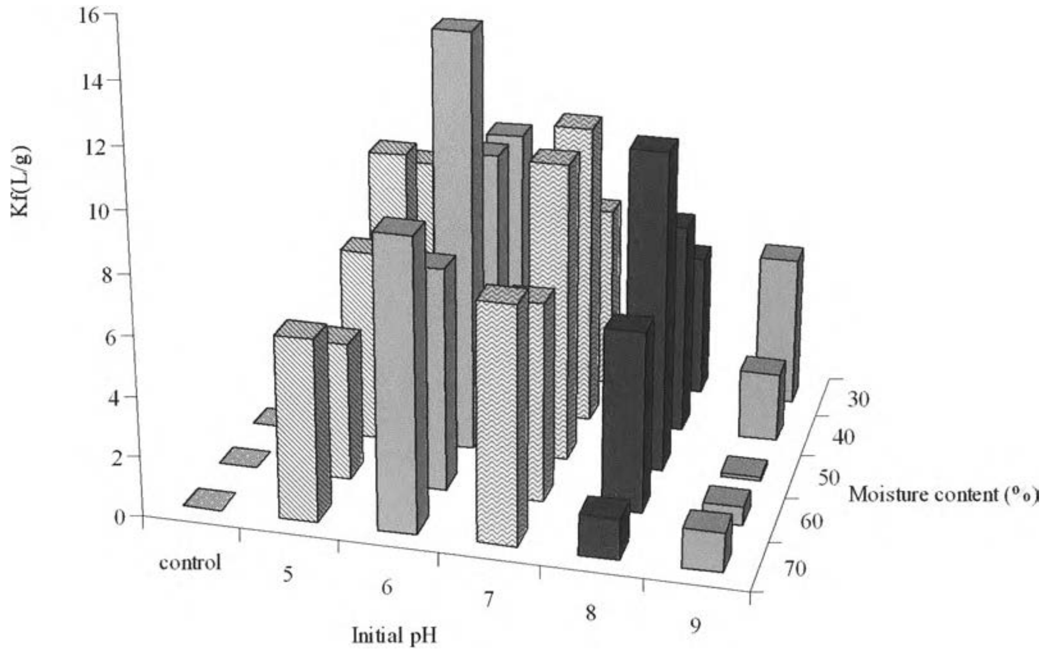

Figure 4.8 Freundlich coefficients (K_f) of copper of the control and grass clippings after composting at different pHs and MCs.

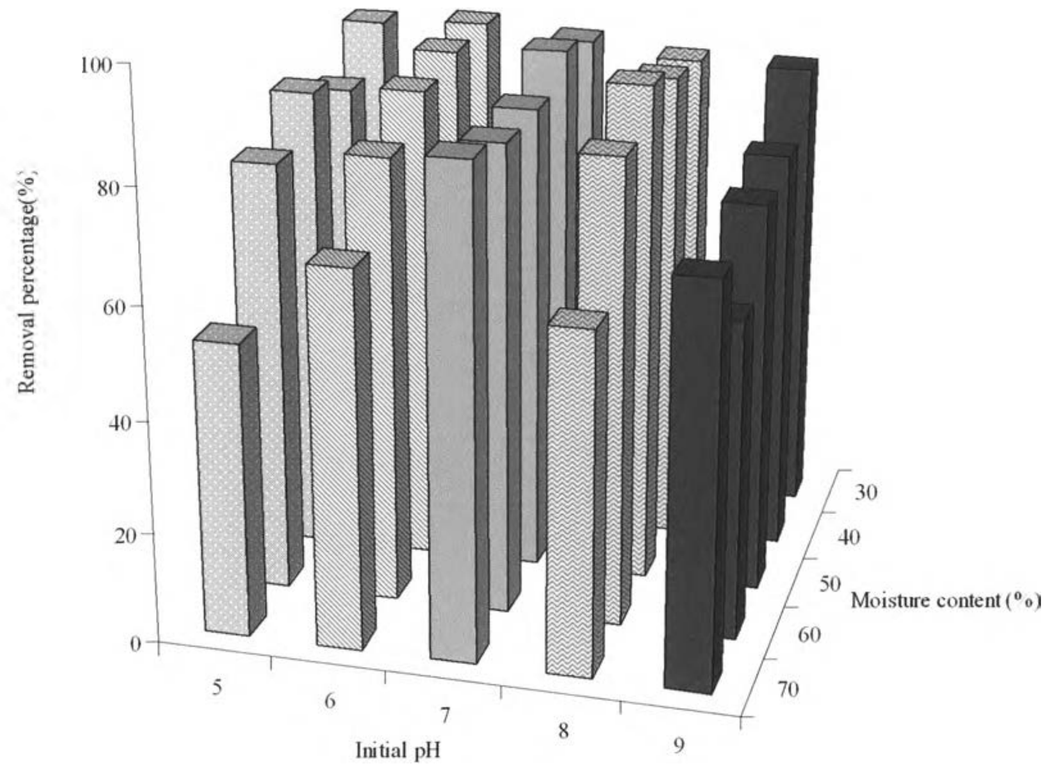

Figure 4.9 Copper removal percentage of grass clippings after composting at different pHs and MCs.

Table 4.6 shows the Cu removal percentages at the minimum (0.3 ppm) and maximum (6.7 ppm) concentrations used in isotherm tests. Unlike the Cd removal, the lowest percentage occurred at the minimum concentration of Cu while the highest removal was obtained the maximum concentration. In the control test, the Cu solution concentration was 4.2 ppm, the mass of non-composted grass was 0.01-0.20 g. The Cu removal percentages for the maximum, 0.02 g, and minimum mass were 53.11, 52.87 and 41.63%, respectively.

Table 4.6 The copper removal percentages at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	Removal percentage range (%)
30/5	35.69 - 85.44
30/6	42.06 - 86.48
30/7	28.72 - 84.58
30/8	21.16 - 82.34
30/9	22.97 - 82.03
40/5	64.65 - 78.15
40/6	65.88 - 86.54
40/7	59.01 - 87.98
40/8	49.00 - 84.54
40/9	18.62 - 71.99
50/5	52.74 - 83.27
50/6	47.15 - 85.03
50/7	52.09 - 83.23
50/8	65.33 - 89.01
50/9	15.81 - 69.78
60/5	51.87 - 76.71
60/6	59.03 - 79.38
60/7	42.69 - 83.37
60/8	44.49 - 82.71
60/9	13.98 - 56.62
70/5	65.77 - 81.39
70/6	50.41 - 86.82
70/7	54.51 - 86.80
70/8	21.45 - 60.66
70/9	5.99 - 70.83

Similar to the Cd results, q (mg Cu/g compost) values in Figure 4.10 exhibit comparable trends with the removal percentages in Figure 4.9. The q values in Figure 4.10 were calculated from the maximum concentration. Table 4.7 presents the range of q at the minimum and maximum concentrations used in the isotherm tests. The lower Cu concentration in the solution, the lower q was obtained. Similar to the q results of Cd sorption, the control grass had much lower q than the compost at the maximum Cu concentration: 4.35, 2.76, and 0.28 mg Cu/g grass for 0.01, 0.02, and 0.20 g of grass, respectively.

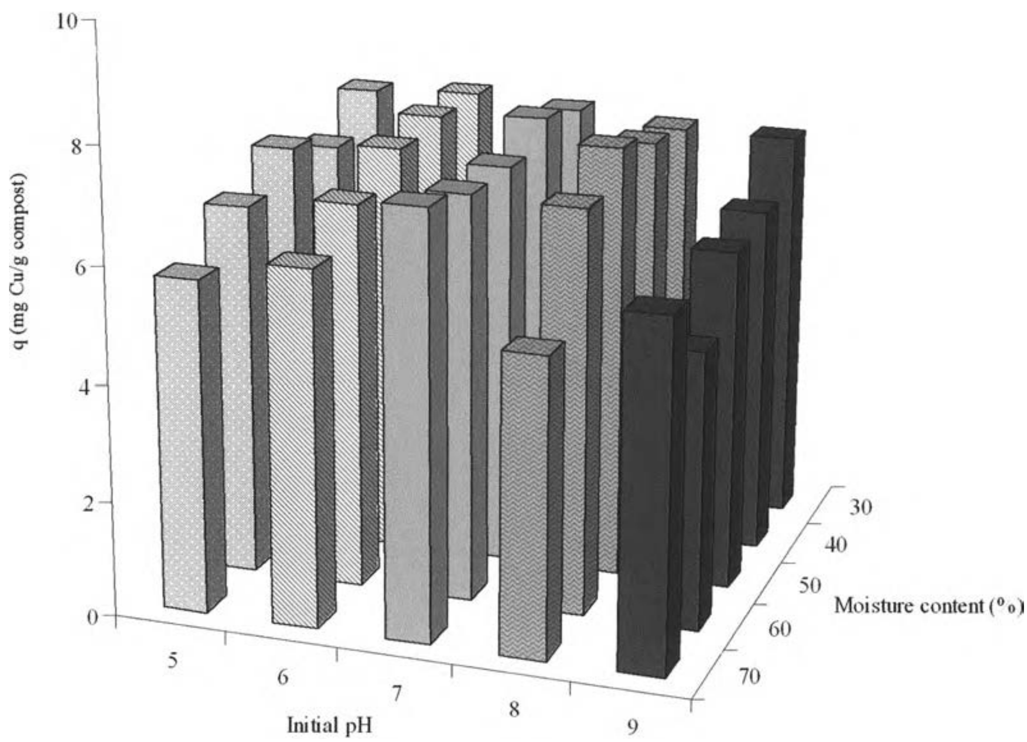

Figure 4.10 Copper adsorptive capacities (q) of grass clippings after composting at different pHs and MCs.

Table 4.7 The copper adsorptive capacity (q) at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	q (mg Cu/g compost)
30/5	0.12 - 7.19
30/6	0.15 - 7.27
30/7	0.10 - 7.11
30/8	0.07- 6.93
30/9	0.08 - 6.90
40/5	0.23 - 6.57
40/6	0.23 - 7.28
40/7	0.21 - 7.40
40/8	0.17 - 7.11
40/9	0.06 - 6.06
50/5	0.18 - 7.00
50/6	0.16 - 7.15
50/7	0.18 - 7.00
50/8	0.23 - 7.49
50/9	0.07 - 5.87
60/5	0.18 - 6.45
60/6	0.21 - 6.68
60/7	0.15 - 7.01
60/8	0.15 - 6.96
60/9	0.11 - 4.76
70/5	0.23 - 5.74
70/6	0.18 - 6.12
70/7	0.19 - 7.30
70/8	0.14 - 5.10
70/9	0.02 - 5.96

4.2.2.3 Lead Adsorption Performances

Figure 4.11 presents K_f of lead adsorption of the control and grass clipping after composting at different pHs and MCs. At 30% MC, initial pH did not influence K_f which was poor compared with those at the other moisture contents. At 40% MC, K_f was high at pH 8 while at 50% MC, pH 7 was optimal. The maximum K_f was obtained at initial pH 6 and 60% MC. When the MC was 40 and 50%, initial pH 8 and 7, respectively, provided the highest K_f. MC had no effect on K_f when initial pH was 9. It should be noted that the K_f scale in Figure 4.11 is substantially different from the scales in Figures 4.5 and 4.8: K_f of Pb sorption were not less than those of Cd and Cu sorption. The K_f of the non-composted grass suggests that composting increased the K_f values of the grass clippings.

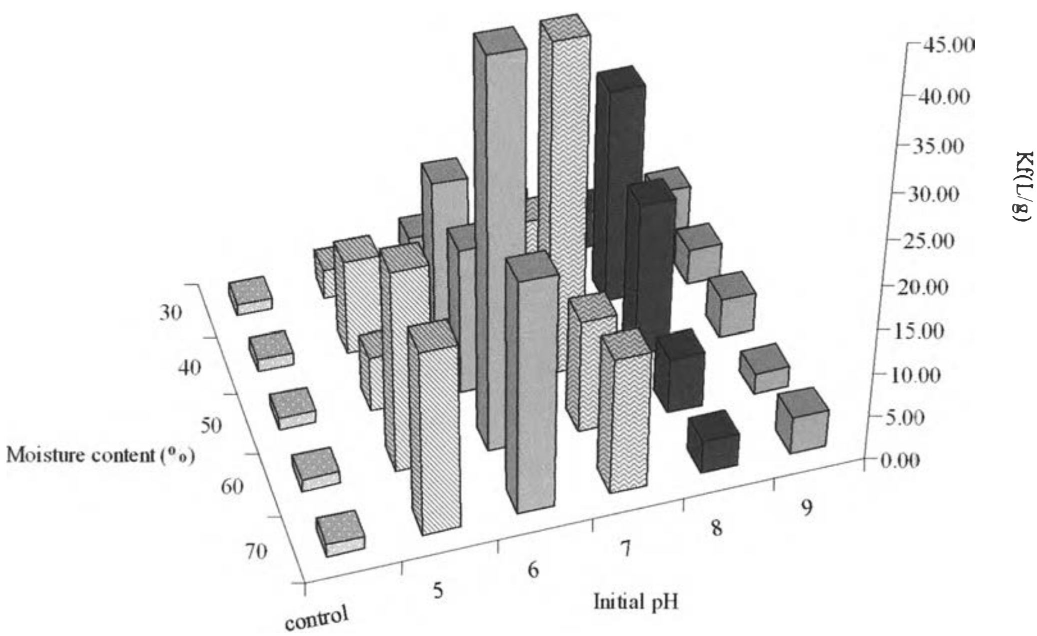

Figure 4.11 Freundlich coefficients (K_f) of lead of the control and grass clippings after composting at different pHs and MCs.

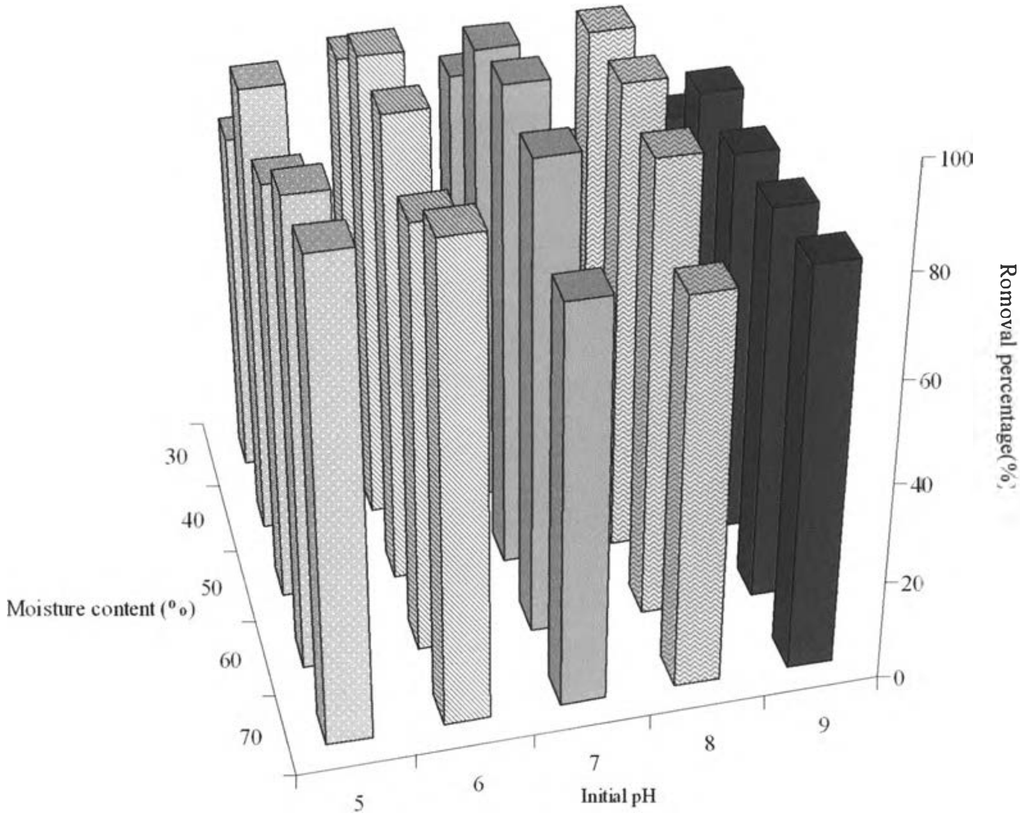

Figure 4.12 Lead removal percentage of grass clippings after composting at different pHs and MCs.

Figure 4.12 shows that all composts have high and comparable removal percentages. The removal was not pH and MC dependent. Except at 30% MC, the removal agrees well with the CEC results (Figure 4.4). The removal percentages were calculated based on the maximum Pb concentration (6.4 ppm). Table 4.8 shows the Pb removal percentages at the minimum (0.1 ppm) and maximum (6.4 ppm) concentrations used in the isotherm tests. The lowest removal was obtained the minimum concentration while the highest removal occurred at the maximum concentration. The removal percentage ranges in Table 4.8 are different in magnitude; some are wide while some are not. In the control test, the solution concentration was 2.9 ppm, the mass of non-composted grass was between 0.01 and 0.20 g. The Pb removal percentages at the maximum, 0.02 g, and minimum mass were 86.8, 85.1, and 80.1%, respectively.

Table 4.8 The lead removal percentages at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	Removal percentage range (%)
30/5	64.00 - 68.20
30/6	78.25 - 81.35
30/7	21.49 - 75.32
30/8	49.97 - 57.17
30/9	52.41 - 61.61
40/5	42.45 - 88.81
40/6	57.03 - 92.24
40/7	82.25 - 90.90
40/8	43.61 - 91.43
40/9	69.89 - 77.41
50/5	46.53 - 82.44
50/6	53.43 - 92.35
50/7	50.20 - 94.93
50/8	53.22 - 92.48
50/9	28.36 - 76.51
60/5	74.86 - 91.94
60/6	27.08 - 84.30
60/7	37.79 - 92.82
60/8	70.38 - 89.99
60/9	72.62 - 77.98
70/5	45.84 - 93.77
70/6	19.59 - 93.55
70/7	75.02 - 79.14
70/8	15.34 - 77.23
70/9	35.65 - 79.57

Figure 4.7 presents q or mg sorbate/g sorbent at the maximum Pb concentration used in the isotherm test. As expected, q (mg Pb/g compost) values were high and were not dramatically affected by initial pH and MC. Table 4.7 presents the ranges of q based on the minimum and highest maximum concentrations. At the minimum concentration, q was extremely low and comparable among the 25 composts. The non-composted grass provided q values comparable to the composted grass. The high q value, 6.36 mg Pb/g grass, was from the minimum mass of grass while the maximum mass provided q of 0.30 mg Pb/g grass. At the same mass as the compost, q was 3.00 mg Pb/g grass.

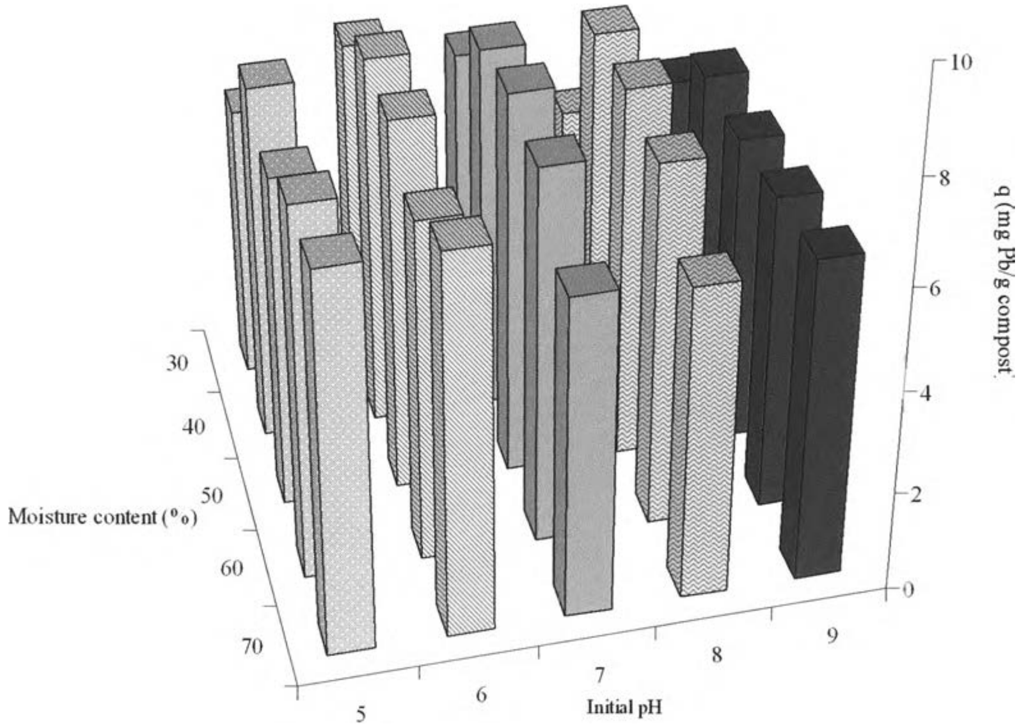

Figure 4.13 Lead adsorptive capacities (q) of grass clippings after composting at different pHs and MCs.

Table 4.9 The lead adsorptive capacity (q) at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	q (mg Pb/g compost)
30/5	0.09 - 5.42
30/6	0.08 - 6.47
30/7	0.02 - 5.99
30/8	0.07 - 4.54
30/9	0.07 - 4.90
40/5	0.04 - 7.06
40/6	0.06 - 7.33
40/7	0.01 - 7.23
40/8	0.04 - 7.27
40/9	0.07 - 6.15
50/5	0.05 - 6.55
50/6	0.05 - 7.34
50/7	0.05 - 7.55
50/8	0.05 - 7.35
50/9	0.03 - 6.08
60/5	0.07 - 7.31
60/6	0.03 - 6.70
60/7	0.04 - 7.38
60/8	0.07 - 7.15
60/9	0.07 - 6.20
70/5	0.05 - 7.45
70/6	0.02 - 7.44
70/7	0.08 - 6.29
70/8	0.02 - 6.14
70/9	0.04 - 6.32

4.2.2.4 Zinc Adsorption Performances

Figure 4.14 illustrates that K_f for Zn sorption was dependent upon the initial pH of the compost; it increased with increasing pH for most cases. Higher K_f of the compost were obtained at initial pH 8 and 9 regardless at each MC tested. pH 9, the highest pH studied. provided the highest K_f at 40% MC but was less favorable at some moisture contents compared with pH 8. The non-composted grass provided extremely low K_f compared to all composted grass.

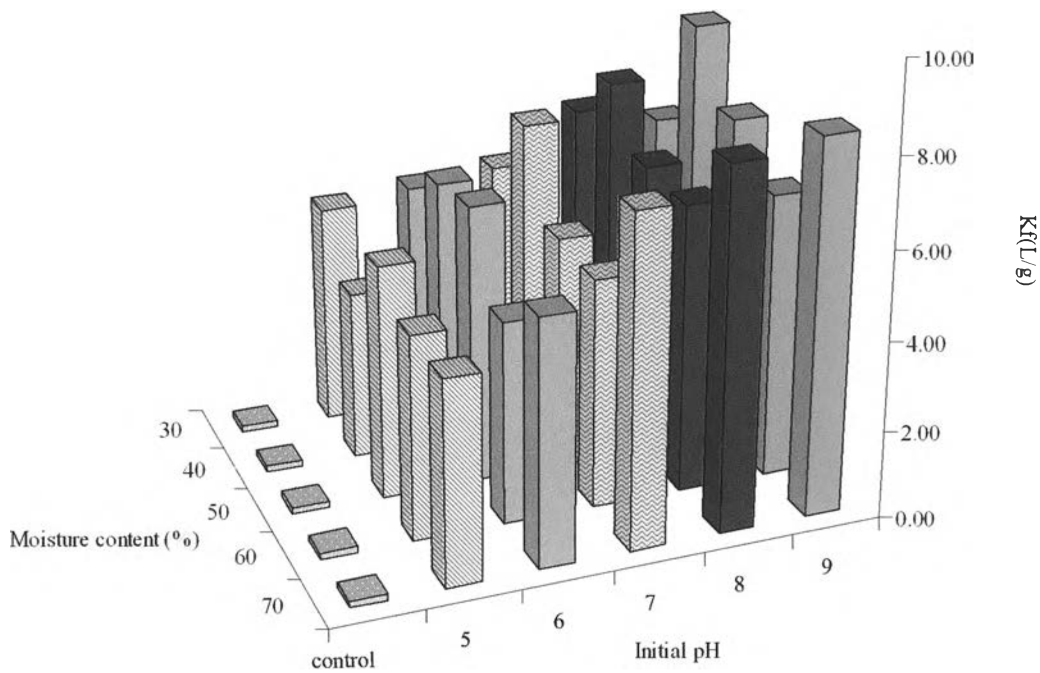

Figure 4.14 Freundlich coefficients (K_f) of zinc of the control and grass clippings after composting at different pHs and MCs.

Figure 4.15 shows that pH 9 provided highest removal percentage at the maximum Zn concentration (10.7 ppm) for all MCs. Unlike the K_f results, the effect pH on the removal was not strong. However, pH was still more controlling than MC. Table 4.8 shows the Zn removal percentages at the minimum (0.5 ppm) and maximum (10.7 ppm) Zn concentrations used in isotherm tests. The 0.5 ppm concentration provided the high removal percentage while the 10.7 ppm concentration resulted in the lowest percentage. The removal ranges were very narrow for all 25 composts. The Zn concentration used in the control test was 4.3 ppm and the mass of non-composted grass ranged from 0.01 to 0.20 g. The Zn removal percentage using the maximum, 0.02 g, and minimum mass was 67.14, 49.77, and 24.32%, respectively, much lower than those of the grass compost. The compost removed Zn more effectively than the normal grass.

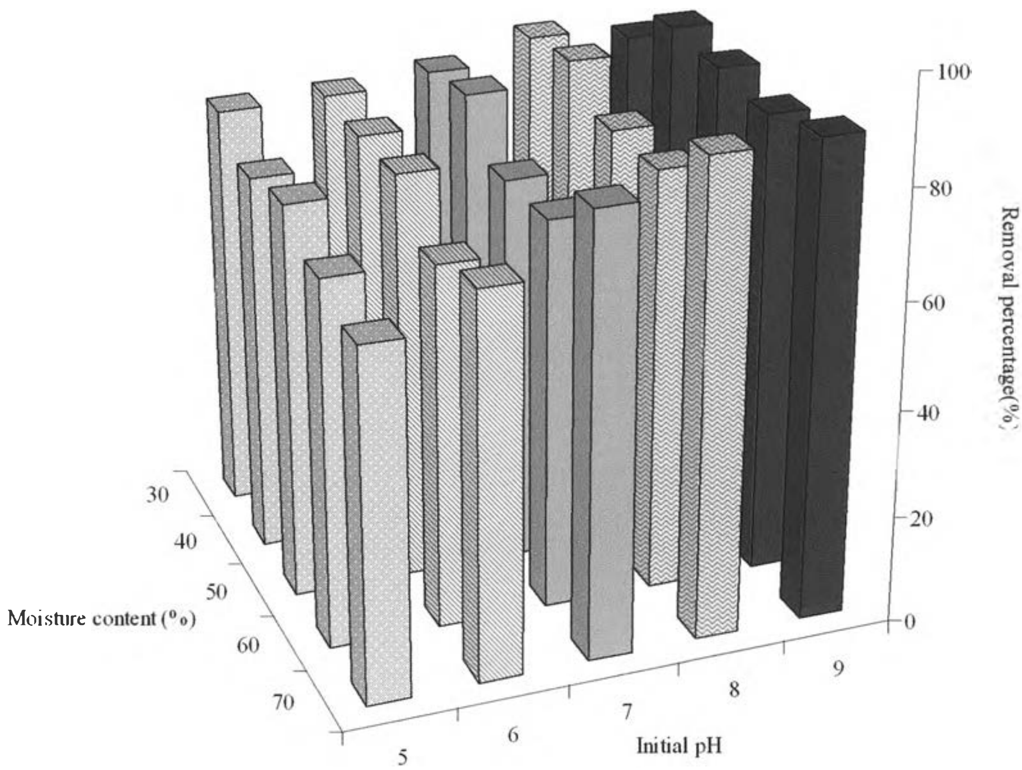

Figure 4.15 Zinc removal percentage of grass clippings after composting at different pHs and MCs.

Table 4.10 The zinc removal percentages at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	Removal percentage range (%)
30/5	76.39 – 84.65
30/6	76.98 – 80.74
30/7	79.01 – 86.07
30/8	83.25 – 87.30
30/9	81.07 – 85.25
40/5	70.83 – 77.00
40/6	76.04 – 88.13
40/7	81.19 – 89.24
40/8	84.96 – 90.05
40/9	88.96 – 89.54
50/5	73.40 – 82.35
50/6	76.04 – 85.95
50/7	72.19 – 86.49
50/8	78.73 – 86.67
50/9	87.60 – 95.10
60/5	68.00 – 83.67
60/6	67.33 – 84.26
60/7	72.31 – 84.53
60/8	78.43 – 93.33
60/9	85.68 – 89.45
70/5	64.62 – 90.92
70/6	71.08 – 93.32
70/7	81.71 – 95.65
70/8	88.00 – 90.07
70/9	88.38 – 90.44

The q (mg Zn/g compost) values at the maximum Zn concentration shown in Figure 4.16 followed the removal percentages in Figure 4.15. pH 9 provided highest removal percentage for all MCs and pH had a mild effect on q. Lower q shown in Table 4.9 was obtained at the minimum Zn concentration. All 25 composts had the q ranges that were not much different. The control grass had the q values markedly less than the values of the compost at the maximum Zn concentration as shown in Table 4.9. The q of the control at 0.20, 0.02, and 0.01 g grass mass was 0.36, 2.65, and 2.59 mg Zn/g grass, respectively.

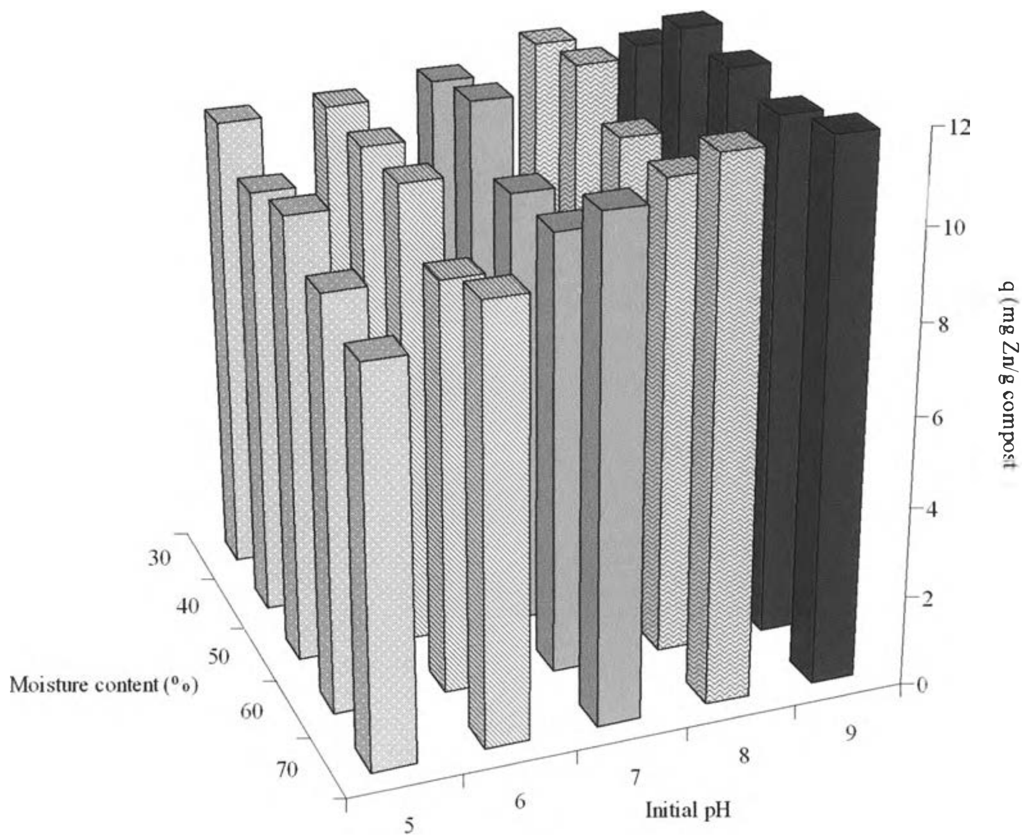

Figure 4.16 Zinc adsorptive capacities (q) of grass clippings after composting at different pHs and MCs.

Table 4.11 The zinc adsorptive capacity (q) at minimum and maximum concentrations used in the isotherm test of all composts (25types)

Composting condition (% MC/ initial pH)	q (mg Zn/g compost)
30/5	0.51 - 10.21
30/6	0.53 - 10.29
30/7	0.51 - 10.56
30/8	0.56 - 11.13
30/9	0.53 - 10.84
40/5	0.50 - 9.47
40/6	0.57 - 10.17
40/7	0.58 - 10.85
40/8	0.56 - 11.36
40/9	0.54 - 11.89
50/5	0.54 - 9.81
50/6	0.56 - 10.17
50/7	0.56 - 9.65
50/8	0.56 - 10.52
50/9	0.49 - 11.71
60/5	0.54 - 9.09
60/6	0.55 - 9.00
60/7	0.55 - 9.67
60/8	0.64 - 10.48
60/9	0.52 - 11.45
70/5	0.64 - 8.64
70/6	0.64 - 9.50
70/7	0.65 - 10.92
70/8	0.56 - 11.76
70/9	0.57 - 11.81