RESIDUAL CADMIUM CONTENT IN SOIL AND *EMPON-EMPON* AND THE EFFICIENCY OF BINDING AGENTS ON IMMOBILIZATION OF CADMIUM IN SOIL

THESIS REPORT

Submitted in Partial Fulfillment for the Requirement of Master of Science Degree, in Environmental Science Specialization in Natural Resources and Environmental Management.

By

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ENVIRONMENTAL SCIENCE STUDY PROGRAM
SEBELAS MARET UNIVERSITY POSTGRADUATE PROGRAM
SURAKARTA
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<th>Examiner’s Charge</th>
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DECLARATION OF THESIS OWNERSHIP, ORIGINALITY AND PUBLICATION REQUIREMENTS

1. I, Arlindo Fernando Macie, certify that this thesis with the title “Residual Cadmium Content in Soil and Empon-Empon and the Efficiency of Binding Agents on Immobilization of Cadmium in Soil” comprises only my original research towards the Master degree and its content has not been submitted or presented in any form for another degree at any University or other academic forums, except where citations have been made in this thesis to acknowledge the respective authors. Therefore, I will be responsible of any sanction or penalty, if a part of the content of this thesis found previously published.

2. The partial or full publication of the content of this thesis in a journal or scientific forum has to include the committee of Advisors as authors and the UNS Postgraduate program. In case of violation of these rules of publication I will be responsible for any academic penalty resulting from such violation.

Surakarta, 6th June 2016

Arlindo Fernando Macie
A.131408019
DEDICATION

First of all I dedicate these outcomes to the Almighty God for His guidance and protection under the sun. I also thank God for boosting me with energy and wisdom, because without Him nothing of which I have achieved would be possible.

This thesis is dedicated to my Father, Fernando Macie and my mother Cecília Muchanga for having brought me to the light, and for being unconditionally supportive whenever I needed them. Special dedication I address to my mother for her moral support every single day; she is a real champion in person. This thesis is also dedicated to some special people in my life namely, Wahyu, Bowen, Heitor, and my grandma Tinhala, for inspiring me on a daily basis, and because of them, I find a reason to stand up, lift my head and fight.
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I am using this rare and grand opportunity to express my gratitude to everyone who has supported me throughout the course of this Master degree in environmental studies. I am very grateful for the inspiring guidance and invaluably constructive criticism during the research.

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I also thank my fellow laboratory mates, Arwa and Ahzar, for each opportunity of sharing and the togetherness which we have experienced during this restless time, and also the staff of the Soil Science Laboratory, for their humbleness and support. They have increased the spirit of teamwork in me, and in the meantime have helped me to more quickly adapt to the lab environment, which is quite demanding in terms of energy and time.

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ABSTRACT

Arlindo Fernando Macie. A.131408019. 2016. Residual Cadmium Content in Soil and Empon-Empon and the Efficiency of Binding Agents on Immobilization of Cadmium in Soil. Thesis. 1st Advisor: Dr. Prabang Setyono, M.Si, Lecturer at Environmental Science Department, Postgraduate programme, Sebelas Maret University 2nd Advisor: Dr. Ir. Widyatmani Sih Dewi, MP, Lecturer at Faculty of Agriculture.

Medicinal and spice herbs have been of great importance since the ancient ages. People have relied much on them to fulfill their healthcare needs and as ingredients of diverse cuisines. Currently, the cultivation of medicinal plants based on agro-chemicals has posing lives because chemicals contain toxic elements, including Cadmium. This research determined the Cd concentrations on soil and medicinal and spice plants, and determined the efficiency of three binding agents on immobilization of Cd in three soil types sampled in Karanganyar. Soil cores and rhizomes were sampled and analyzed for soil properties and Cd content. Three soil types were incubated in triplicate. Each soil (5 g) was treated with 0.2 g of dolomite, 1.0g of charcoal and organic fertilizer by adding 8 ml of distilled water in a 50 ml tube, and then incubated for 24 days after having been shaken for 16 h. were added 1ml of (HNO₃ and 3 ml KClO₄ to the mixture. The mixture was first heated at 80°C and then at 130°C till the orange smoke gets finished. Finally Cd was extracted with solution of 0.01 CaCl₂ (20 ml), and measured by AAS. The results showed that Cd in all the investigated villages still below the limits (1.0 mg Cd/kg). In soils Cd ranged from 0.224 to 0.354 mg Cd/kg, while in herbs ranged from 0.0285 to 0.0594 mg Cd/kg. Dolomite showed the highest efficiency (95.43%) followed by organic fertilizer (92.64%) and charcoal (91.53%) in Alfisols. In general dolomite was the better binding agent in each location, while the lowest efficiency was recorded with organic fertilizer (89.30%) in Mediterranean soils from Kemuning.

Keywords: Immobilization; medicinal plants; Cadmium; binding agents; efficiency.
ABSTRAK


Obat herbal dan rempah-rempah sudah menjadi hal yang penting dari zaman dahulu kala. Orang-orang lebih mengandalkan obat herbal dan rempah-rempah untuk perawatan kesehatan ataupun untuk menambah cita rasa dalam masakan. Budidaya tanaman herbal berbasis pupuk kimia telah banyak dikembangkan, oleh karena itu, elemen-elemen toksik termasuk cadmium, memasuki rantai makanan. Penelitian ini bertujuan untuk mengetahui konsentrasi Cd tanah dan tanaman herbal, serta menganalisis efisiensi yang mengikat tiga agen imobilisasi Cd dalam tiga jenis tanah di Karanganyar. Sampel tanah dan rimpang diteliti untuk unsur tanah dan Cd. Tiga diantaranya diinkubasi dalam rangkap tiga. Setiap tanah (5 g) diberi pelakuan 0.2 g dolomit, 1.0 g arang dan pupuk organik dengan menambahkan 8 ml air suling dalam tabung 50 ml, kemudian tanah tersebut diinkubasi selama 24 hari setelah diaduk selama 16 jam. Setelah itu tambahkan 1 ml HNO₃ dan 3 ml KClO₄ ke dalam campuran. Pertama panaskan tanah pada suhu 80°C sampai 130°C hingga asap berwarna oranye. Kemudian Cd diekstrasi dengan larutan 0,01 CaCl₂ (20 ml), lalu diukur dengan AAS. Dari hasil penelitian menunjukan bahwa Cd dari semua desa yang diteliti masih dibawah batas ambang (1,0 mg Cd/kg). Cadmium di tanah berkisar antara 0,224-0,354 mg Cd/kg, sementara di jamu berkisar antara 0.0285 – 0.0594 mg Cd/kg. Dolomit menunjukkan efisiensi tertinggi (95.43%) diikuti oleh pupuk organik (92.64%) dan arang (91.53%) di Alfisols. Pada kesuluran efisiensi dolomit lebih besar di semua tanah dan lokasi, sedangkan efisiensi terendah tercatat dengan pupuk organik (89.30%) di tanah Mediteran dari Kemuning.

Kata kunci: Imobilisasi; tanaman herbal; Kadmium; Agen terkait; efisiensi.
CONTENT LIST

DECLARATION OF THESIS OWNERSHIP, ORIGINALITY AND PUBLICATION REQUIREMENTS

DEDICATION

ACKNOWLEDGEMENT

ABSTRAK

LIST OF TABLES

TABLE OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

CHAPTER I

INTRODUCTION

A. Background

B. Statement of the problem

C. Objectives

D. Significance of the research

1. Medicinal herbs farmers in the Karanganyar district

2. Government of the Karanganyar district

3. Academics and society

CHAPTER II

THEORETICAL BASIS

A. Literature Review

1. Production of herbal plants

2. Production and uses of Ginger (Zingiber officinale)

3. Factors affecting the production of turmeric

4. Uses of Turmeric

5. Factors affecting the production of Javanese ginger

6. Characteristics of Cadmium and its occurrence in Soils

7. Geochemical occurrence of Cadmium

8. Origin of Cadmium in soils

9. The chemical behaviour of Cadmium in soils

10. Effects of pH on Cadmium adsorption in soils

11. Effects of competition from other metal ions
12. Adsorption on Calcite ................................................................. 21
13. Effects of organic ligands and Chloride ions on Cadmium adsorption.... 21
14. Effect of Soil organic matter on Cadmium adsorption and availability .... 22
15. Soil factors affecting the Uptake of Cadmium by plants .......................... 23
16. Plant factors affecting the uptake of Cadmium from soils .................... 26
17. Negative effects of Cadmium on humans, animals, and plants .............. 27
18. Description of soil characteristics ...................................................... 29
    a. Characteristics of Andosols ..................................................... 29
B. Relevant Studies ............................................................................. 34
D. Hypotheses ..................................................................................... 39

CHAPTER III ..................................................................................... 40
MATERIAL AND METHODS .......................................................... 40
    A. Location and research period ......................................................... 40
    B. Research design ........................................................................... 42
        1. Research type ........................................................................ 42
        2. Population and samples ............................................................. 42
        3. Variables of study ................................................................... 43
        4. Data collection and procedures ............................................... 43
        5. Material .................................................................................. 47
   Table 1. Materials used in the field and laboratory ................................ 47
    C. Laboratory methods ..................................................................... 47
        1. Atomic Absorption spectrometer (AAS) ..................................... 47
        2. Determination of Soil pH ............................................................ 48
        3. Determination of Soil Organic Matter ....................................... 49
        4. Analysis of Soil Cation Exchange Capacity (CEC) ................. 51
        5. Analysis of soil texture ............................................................... 53
        6. Analysis of Cadmium content in soil samples ......................... 57
        7. Analysis of Cadmium content in plant tissues ........................... 58
        8. Lab experiment of immobilization of Cadmium in soils ............ 60
    D. Process of immobilization of Cd by organic materials and activated carbon 62
    E. Statistical Analysis ..................................................................... 62

CHAPTER IV ..................................................................................... 64
RESULTS AND DISCUSSION ...................................................... 64
    A. Field Survey ............................................................................. 64
1. Soil properties and precipitation patterns of the Study location .......................... 64
20. Analysis of Cadmium concentrations in soils from Karanganyar.............. 67
21. Analysis of Cadmium content in rhizomes of medicinal and spice plants.... 72
22. T-Test for comparison of means of soil Characteristics and Cd in soils and herbs 74

B. Results of Pearson correlation........................................................................ 81
C. Stepwise regression analysis........................................................................ 86

D. Laboratory Experiment on Immobilization of Cadmium.............................. 93
   1. Effect of three binding agents on immobilization of cadmium in soils under medicinal plants cultivation ................................................................. 93
   2. Analysis of pH of soil treated with binding agents ........................................ 101
   3. Outputs and outcomes of mitigation of Cadmium in soils ................................ 104
   4. Adaptation strategies to Cd dynamics in plants and soil ............................... 108

E. Socio-economic analysis............................................................................. 110

CHAPTER V ........................................................................................................ 119
CONCLUSION AND RECOMMENDATION ............................................. 119
   A. Conclusion.................................................................................................. 119
   B. Recommendations .................................................................................. 120

APPENDIX 1 .................................................................................................... 127
APPENDIX 2 .................................................................................................... 132
LIST OF TABLES

Table 1. Materials used in the field and laboratory 47
Table 2. Soil Characteristics of the research sites 65
Table 3. Cadmium Concentration in Soil (mg Cd/kg) from Karanganyar 68
Table 4. Cadmium Concentration in Rhizomes 73
Table 5. Two Tailed t-Test of paired of pH Averages 75
Table 6. T-test for Averages of paired groups of Soil organic matter 76
Table 7. Two Tailed t-Test for Averages of paired groups in Soil 77
Table 8. t-Test for Averages of Paired groups of Cd in Rhizomes 78
Table 9. Table 9 t-Test for averages of paired groups of Cd averages in rhizomes of Turmeric 79
Table 10. T-test for Averages of paired groups of Cadmium in Rhizomes of Javanese ginger 79
Table 11. t-Test for paired means of Cd in three medicinal herbs. 80
Table 12. Pearson’s correlation in Kemuning at 15 cm soil depth 82
Table 13. Pearson’s correlation in Kemuning at 30 cm soil depth 82
Table 14. Pearson’s correlation in Bakalan at 15 cm soil depth 83
Table 15. Pearson’s correlation in Bakalan at 30 cm soil depth 83
Table 16. Pearson’s correlations in Tamnsari at 15 cm soil depth 84
Table 17. Pearson’s correlations in Tamansari at 30 cm soil depth 85
Table 18. Pearson’s correlations in Sambirejo at 15 cm soil depth 85
Table 19. Pearson’s correlations in Sambirejo at 30 cm soil depth 86
Table 20. Soil properties and Cd concentration in the study location. 93
Table 21. ANOVA of Cadmium versus soil and adsorbents 94
Table 22. Advanced tukey’s test for means of cadmium content in soil solution 95
Table 23. Advanced tukey’s test for means of binding agents in the soil solution 96
Table 24. Advanced Tukey’s test for Cd in soil solution versus combined factors 98
Table 25. ANOVA of pH versus soil and adsorbents 102
Table 26. Advanced tukey’s test for soil pH average 102
Table 27. Educational background 111
Table 28. Use of chemical fertilizers 112
Table 29. Frequency and period of fertilization  112

Table 30. Types of organic fertilizers applied  113

Table 31. Effect of organic fertilizer on yields  114

Table 32. Perception of the farmers shifting to organic farming  115

APPENDIX LIST

APPENDIX 1  127

APPENDIX 2  132
# TABLE OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ginger Plant</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Rhizomes of Ginger</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Turmeric Plant</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Rhizomes of Turmeric</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Dried Rhizomes</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Ground Rhizomes of Turmeric</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>Javanese Ginger Plant</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>Rhizomes of Javanese Ginger</td>
<td>14</td>
</tr>
<tr>
<td>9</td>
<td>Research Location</td>
<td>41</td>
</tr>
<tr>
<td>10</td>
<td>Soil Sampling Using an Auger</td>
<td>45</td>
</tr>
<tr>
<td>11</td>
<td>Sampling Scheme (Harrell, 2014)</td>
<td>46</td>
</tr>
<tr>
<td>12</td>
<td>pH meter</td>
<td>49</td>
</tr>
<tr>
<td>13</td>
<td>Air dried Rhizomes indoor</td>
<td>51</td>
</tr>
<tr>
<td>14</td>
<td>Shaker</td>
<td>51</td>
</tr>
<tr>
<td>15</td>
<td>Analytical weighing Scale</td>
<td>52</td>
</tr>
<tr>
<td>16</td>
<td>Filtration Process and Washing with alcohol</td>
<td>52</td>
</tr>
<tr>
<td>17</td>
<td>Distillation Chamber</td>
<td>53</td>
</tr>
<tr>
<td>18</td>
<td>Heating the Solution of HCl</td>
<td>55</td>
</tr>
<tr>
<td>19</td>
<td>Heating the Solution of H₂O₂</td>
<td>55</td>
</tr>
<tr>
<td>20</td>
<td>Cooling of Solutions and H₂O₂</td>
<td>55</td>
</tr>
<tr>
<td>21</td>
<td>Reaction of H₂O₂ before the heating process</td>
<td>56</td>
</tr>
<tr>
<td>22</td>
<td>Filtration Process</td>
<td>56</td>
</tr>
<tr>
<td>23</td>
<td>Solution with Na₄P₂O₇</td>
<td>56</td>
</tr>
<tr>
<td>24</td>
<td>Textural Triangle</td>
<td>57</td>
</tr>
<tr>
<td>25</td>
<td>Analysis of Cadmium using AAS</td>
<td>59</td>
</tr>
<tr>
<td>26</td>
<td>Extraction of Cadmium from soil and Rhizomes</td>
<td>59</td>
</tr>
<tr>
<td>27</td>
<td>Destruction process of the samples</td>
<td>60</td>
</tr>
<tr>
<td>28</td>
<td>Cattle as a source of manure</td>
<td>67</td>
</tr>
<tr>
<td>29</td>
<td>Collection of Cattle's manure</td>
<td>67</td>
</tr>
</tbody>
</table>
Figure 30. Cadmium Concentration in Inceptisol from Kemuning 68
Figure 31. Cadmium Concentration in Alfisols from Bakalan 69
Figure 32. Cadmium Concentration in Ultisols from Tamansari 69
Figure 33. Cadmium Concentration in Ultisols from Sambirejo 70
Figure 34. Annual rainfall (Source: Department of Agriculture of Karanganyar District 71
Figure 35. Agro-forestry System 72
Figure 36. Fruit Trees combined with medicinal plants 72
Figure 37. Effects of Sand Content on Cd in Rhizomes from Kemuning 87
Figure 38. Clay Content on Cadmium in Rhizomes from Kemuning 88
Figure 39. Effect of Soil pH on Cd in Rhizomes from Kemuning 89
Figure 40. Effect of Sand and Silt Content on Cd in Rhizomes from Bakalan 90
Figure 41. Effect of Clay Content on Cd in Rhizomes from Baklan 90
Figure 42. Effect of Clay content on Cd in Soil from Tamansari 91
Figure 43. Effect of Soil Organic matter on Cd in Rhizomes from Sambirejo 92
Figure 44. Effect of Clay Content on Cd in Rhizomes from Sambirejo 92
Figure 45. Combination of Soil and Adsorbents versus Immobilized Cd 99
Figure 46. Mobile Cd in the Soil Solution versus percentage of Immobilized Cd 100
Figure 47. Cd Dynamics in Soil and plants before ammendment 107
Figure 49. Farmer's Annual Income upon the biofarmaka Clusters 117
# LIST OF ABBREVIATIONS AND ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
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<td>EMPON-EMPON</td>
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<td>Inorganic fertilizer containing Nitrogen Phosphorus and Potassium</td>
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