

CONTENTS

	Page
List of Tables	
List of Figures	
Aim of Work	
1. INTRODUCTION	1
Natural Radionuclides	1
Artificial Radionuclides	2
1.1 Chemistry of the Investigated Elements	2
1.1.1 Cobalt	2
1.1.2 Cesium	3
1.1.3 Europium	5
1.1.4 Lead	6
1.2 Ion Selective electrode	7
1.3 Humic substances	8
1.3.1 History	9
1.3.2 Occurrence	10
1.3.3 Formation	10
1.3.4 Extraction of humic substances	12
1.3.5 Separation	12
1.3.5.1 Fulvic acid	12
1.3.5.2 Humic acid	13
1.3.5.3 Humin	14
1.3.6 Fractionation of humic acid	14
1.3.7 Molecular weight	15
1.3.8 Properties of humic substances	15
1.3.9 Characterization of humic substances	17

1.3.9.1 Elemental composition	17
1.3.9.2 Reactive functional groups	18
1.3.9.3 Spectroscopic characteristics	19
1.3.9.3.1 UV- Visible Spectroscopy	19
1.3.9.3.2 Infrared (IR) spectroscopy	21
1.3.9.4 Potentiometric titration	21
1.3.10 Structure	23
1.3.11 Peat humic substances	26
1.4 Reaction of humic substances with metal ions	29

2. EXPERIMENTAL

2.1 General	31
2.2 Target Materials and Reagents	31
2.3 Preparation of the Radioactive Tracers	31
2.4 Separation and Purification of Humic Materials	33
2.4.1 General	33
2.4.2 Humic acid	33
2.4.3 Fulvic acid	34
2.4.4 Humin	35
2.5 Characterization of Humic Materials	35
2.5.1 Ultimate analysis	35
2.5.2 Potentiometric titration	35
2.5.3 IR Spectroscopy	36
2.5.4 Ultraviolet and visible spectroscopy	36
2.5.5 Functional group analysis	37
1-Total acidity	37
2-Carboxyl groups	39
3-Total OH	39
4-Phenolic OH	40
5-Alcoholic OH	40

6-Carbonyl (C=O)	40
2.5.6 Fractionation of humic acid	41
2.6 Instrumentation	41
2.6.1 General	41
2.6.2 Radioactive measurements	42
2.6.3 Ion selective electrode investigations	43
2.6.3.1 Preparation of ZTP ion exchanger	43
2.7 Interaction of Humic Materials with Metal ions	43
2.7.1 Complexation of metal ions with humic acid	43
2.7.2 Procedures	44
2.7.2.1 Humic acid	44
I- Radioactive investigations	44
2.7.2.1.1 Cesium-humate complexation	44
a) Effect of shaking time	44
b) Effect of Cs ⁺ concentration	44
c) Effect of humic acid concentration	45
d) Effect of pH	45
II- Ion selective electrode investigations	45
2.7.2.1 Cesium- humate precipitation	45
a) Effect of shaking time	46
b) Effect of Cs ⁺ concentration	46
c) Effect of humic acid concentration	46
2.7.2.2 Fulvic acid	46
2.7.2.2.1 Cesium-fulvate precipitation	47
2.7.2.3 Sorption of Cs ⁺ by humin	47
b) Effect of humin weight	47
a) Rate of sorption	48
b) Effect of metal ion concentration	46
2.7.2.1.2 Lead- humate precipitation	48
a) Effect of shaking time	48

b) Effect of Pb^{2+} concentration	49
c) Effect of humic acid concentration	49
2.7.2.4 Fulvic acid	49
2.7.2.4.1 Lead- fulvate precipitation	49
2.7.2.5 Sorption of lead by humin	50
a) Effect of humin weight	50
b) Rate of uptake	50
c) Effect of metal ion concentration	50
d) Effect of competing cations on Lead-humate complex	51
2.8) Disposal of radioactive waste by humic materials	51

3. RESULTS AND DISCUSSION

3.1 Characterization of Humic Materials	52
3.1.1 Ultimate analysis	52
3.1.2 Protonation capacity and pK_a of the carboxylate groups	53
3.1.3 Infrared spectroscopy	83
1.4) Ultraviolet and visible spectroscopy	85
3.1.5 Functional group analysis	87
1) Total Acidity COOH plus phenolic –and / or Enolic-OH	87
2) Carboxyl groups	87
3) Total OH	87
4) Phenolic OH	87
5) Alcoholic OH	88
6) Carbonyl C=O	88
3.2 Interaction of Humic Materials with Metal ions	94
3.2.1 IR investigations	95
3.2.2 Cesium-humate complexation	95
3.2.2.1 Radioactive investigations	101