

# Contents

<b>Preface</b> .....	5
<b>1. Ammonium nitrate(V)1</b> .....	7
1.1. Ammonium nitrate(V) manufacture .....	13
1.1.1. Neutralization .....	15
1.1.2. The Carnit ammonium nitrate(V) process .....	17
1.1.3. The UCB process .....	18
1.1.4. The Stamicarbon process .....	19
1.1.5. The Norsk Hydro Process .....	20
1.1.6. The Stengel process .....	21
1.1.7. The nitro-top process .....	21
1.2. Evaporation .....	22
1.3. Prilling .....	23
1.4. Granulation .....	24
1.5. Fuel .....	25
1.6. Ammonium Nitrate Fuel Oil .....	28
<b>2. Methodology and materials</b> .....	35
2.1. Materials .....	35
2.2. Sample preparation .....	37
2.3. Methodology .....	39
2.3.1. Examination of the low temperature properties of fuel oil .....	39
2.3.2. Examination of AN and ANFO morphology .....	41
2.3.3. Examination of the blasting properties of non-ideal explosives .....	42
<b>3. Results</b> .....	46
3.1. Elemental analysis of fuel oils .....	46
3.2. Low temperature properties of fuel oil .....	47

<b>4. IR analysis</b> .....	53
4.1. Results of IR analysis of ammonium nitrate(V) fertilizer grade .....	53
4.2. Results of IR analysis of ammonium nitrate(V) porous prill .....	54
4.3. Results of IR analysis of fuel oils .....	54
4.4. Results of IR analysis of ANFO based on AN-F .....	57
4.5. Results of IR analysis of ANFO based on AN-PP .....	58
4.6. Results of IR analysis of AN-PP : AN-F mixture with fuel oil .....	59
4.7. Results of IR analysis of ANFO with metal addition .....	61
4.8. IR conclusions .....	62
<b>5. XRD analysis</b> .....	64
5.1. Results of XRD analysis of AN-F and ANFO based on AN-F .....	64
5.2. Results of XRD analysis of AN-PP and ANFO based on AN-PP .....	66
5.3. Results of XRD analysis of AN-PP : AN-F mixture and ANFO based on AN-PP : AN-F mixture .....	69
5.4. Results of XRD analysis of ANFO with a metal addition .....	69
<b>6. SEM analysis</b> .....	72
6.1. Results of the EDS analysis of fuel samples P6-1–P6-5 .....	72
6.2. Results of SEM analysis of ammonium nitrate(V) fertilizer-grade granule .....	74
6.3. Results of SEM analysis of ANFO based on AN-F granule .....	78
6.4. Results of SEM analysis of AN-PP prill .....	80
6.5. Results of SEM analysis of ANFO based on AN-PP .....	83
6.6. Results of SEM analysis of ANFO based on various fuel oils .....	85
6.7. Results of SEM analysis of ANFO based on AN-PP : AN-F mixture .....	96
6.8. Results of SEM analysis of ANFO with metal addition .....	101
<b>7. Blasting properties of non-ideal explosives</b> .....	105
7.1. Heat of explosion results .....	105
7.2. Velocity of detonation .....	109
7.3. Post-blast fumes .....	111
<b>8. Conclusions</b> .....	115
<b>References</b> .....	119
<b>List of internet sources</b> .....	126