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**Recovery of vanadium, and nickel from fly ash produced
from heavy oil-fired electrical power station.**

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Omar Al-chayah**

Abstract

After some preliminary tests, two leaching stages of fly ash to recover vanadium, molybdenum and nickel were selected. A first stage alkaline leaching of fly ash to recover vanadium and molybdenum followed by a second stage sulfuric acid leaching of the residual ash to recover nickel.

The impact of some operational parameters (L/S, leaching temperature, mixing time, and agent leaching concentrations) on the recovery of V, Ni was investigated.

Conditions of precipitation of V and Mo from alkaline medium and Ni from sulfuric acid solution were established.

Keywords: fly ash, leaching, vanadium, nickel, molybdenum

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(Boiler ash) "

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. 1400–1800 °C

(Fly ash)

150–180 °C

(Electrostatic precipitator)

(15%)

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. [9,10]

[]

%

[]

%

(NaOH)

30

%

.%

SO₂
 % (di-(2-ethylhexyl) phosphoric acid) %
 (raffinate) .(tributylphosphate)

-II

.-1.II

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Higher heating value	MJ/Kg	43.25
Lower heating value	MJ/Kg	40.91
Carbon content	%	82.95
Hydrogen content	%	12.75
Nitrogen content	%	0.2
Sulphur content	%	3.44
Ash	%	0.66
Vanadium	ppm	67.5
Sodium	ppm	9.2

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(HF) (3mL HNO₃+1mL HCl) -

(0.2 – 0.5g) -

(HNO₃+H₂SO₄+HClO₄) -

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Fe%	Cr%	Co%	Ni%	Mg%	V%			
							%	
22	0.9	0.1	15	0.3	10	0.017	C.C.D	
20	0.8	0.02	2	0.2	7	0.166	F.A.D	
16.5	0.3	0.04	1.5	0.3	7	0.031	C.C.H	
16	0.1	0.02	0.5	0.05	1.3	1.536	F.A.H	
10	0.1	0.03	15	0.03	7.9	0.01	C.C.M	
10.7	0.03	0.3	10.5	0.03	20	0.107	F.A.M	
21	0.8	0.09	8.3	0.16	15.3	0.0586	C.C.A	
13	0	0	1	0.05	6.5	0.606	F.A.A	

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Combustion chamber Damascus	C.C.D
Fly ash Damascus	F.A.D
Combustion chamber Homs	C.C.H
Fly ash Homs	F.A.H
Combustion chamber Mouhardeh	C.C.M
Fly ash Mouhardeh	F.A.M
Combustion chamber Aleppo	C.C.A
Fly ash Aleppo	F.A.A

-3.II

(Fluka) (%) (%) (%)
 (Sharlau) (%) (Merck) (%)
 (Prolabo) (%) (Analr) (%)

(AAS vario6 Analytik jena)

-4.II

(Electrostatic - °C precipitator)

	(wt.%)	(wt.%)	(wt.%)	(wt.%)
Moisture	0.166	0.156	0.160	0.16
V	5.02	5.03	4.95	5
Ni	1.56	1.52	15.4	1.54
Mo	0.34	0.35	0.36	0.35
Fe	22.22	22.05	21.9	22.05
Cr	0.8	0.78	0.82	0.8
Mg	0.2	0.22	0.19	0.2
Co	0.02	0.025	0.023	0.22

(L/S)

°C

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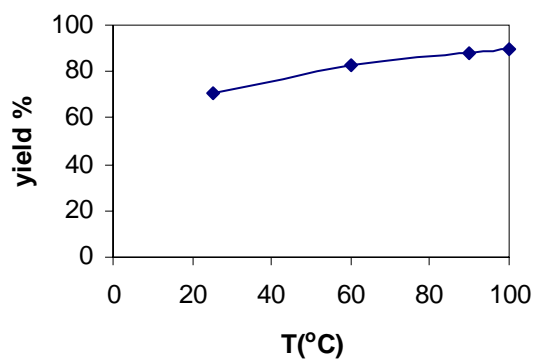
(AAS)

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	V%	Ni%	Mo%	Fe%
H ₂ O	35.5	42.9	3	57.9
H ₃ PO ₄	59.64	85.8	34	79.2
HNO ₃	50.36	75.44	52	79.6
HCl	58.6	86.22	56	81.55
HClO ₄	66.2	75.4	48	2.73
H ₂ SO ₄	66.26	91.01	54	2.91
NaOH	77	0.01	54	0

-III

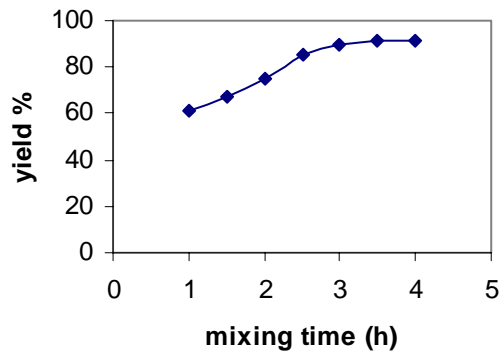
([NaOH] = 8M = / 100 °C =)



:(1)

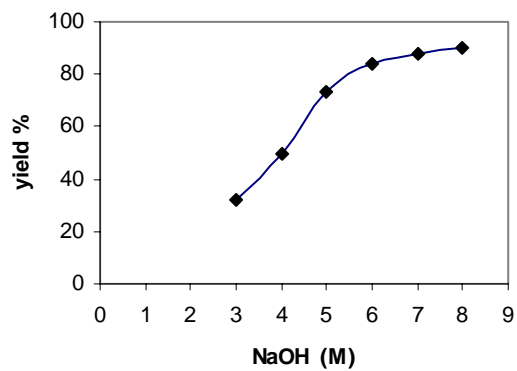
(t = 4h, [NaOH] = 8M, L/S = 5)

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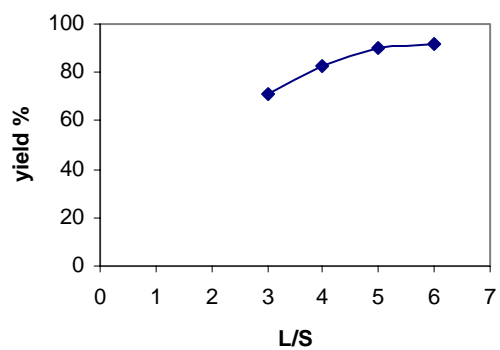
:(2)

(T = 100 °C, L/S = 5, [NaOH] = 8M)



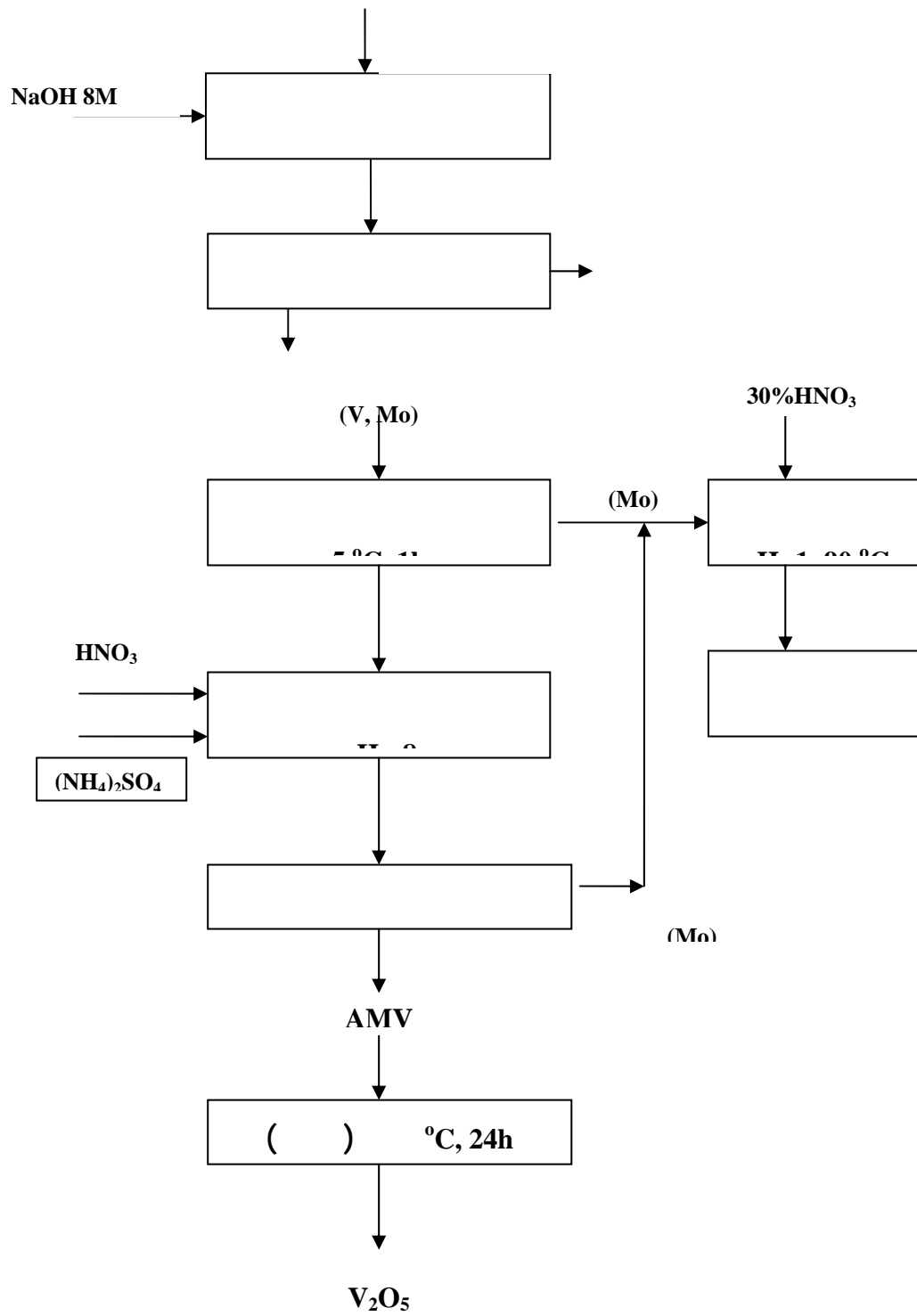
:(3)

NaOH
(t = 4 h, T = 100 °C, L/S = 5)



(L/S) : (4)
 ([NaOH] = 8 M, t = 4 h, T = 100 °C)

(8M) / (0.08%))
 (%)
 pH (H₂MoO₄)
 pH V₂O₅ = 8
 V₂O₅ % 500 °C



: (5)

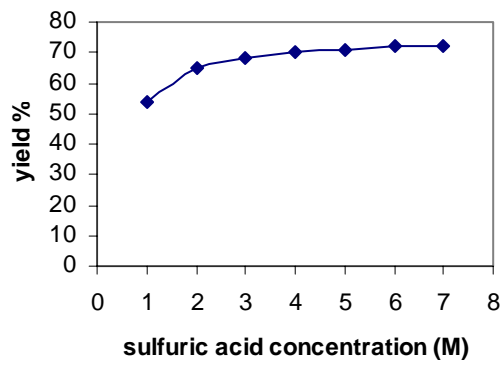
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L/S

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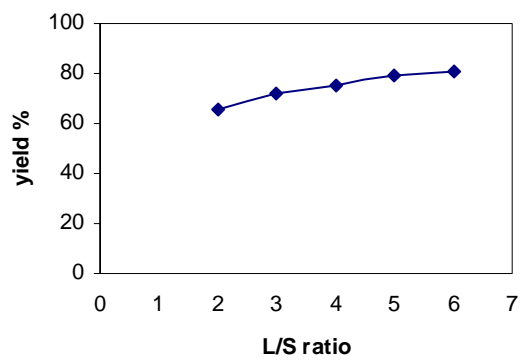
: %

($[\text{H}_2\text{SO}_4] = 5\text{M}$, $T = 100^\circ\text{C}$, $t = 4\text{h}$, $L/S = 4$)



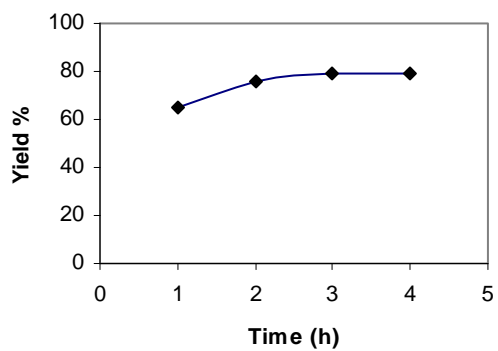
:(6)

($L/S = 3$, $T = 100^\circ\text{C}$, $t = 4\text{h}$)

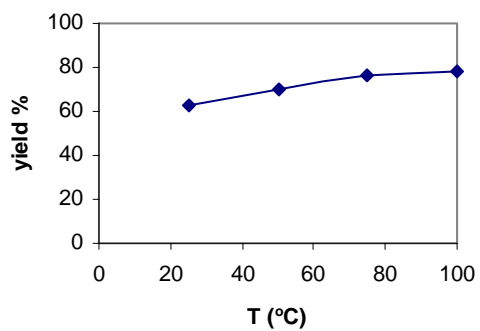


L/S : (7)

($T = 100^\circ\text{C}$, $t = 4\text{h}$, $[\text{H}_2\text{SO}_4] = 5\text{M}$)



:(8)
(L/S= 3, [H₂SO₄] = 5 M, T = 100 °C)



:(9)
(L/S= 3, t = 4 h, [H₂SO₄] = 5 M)

(L/S=4) 100 °C

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pH

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pH

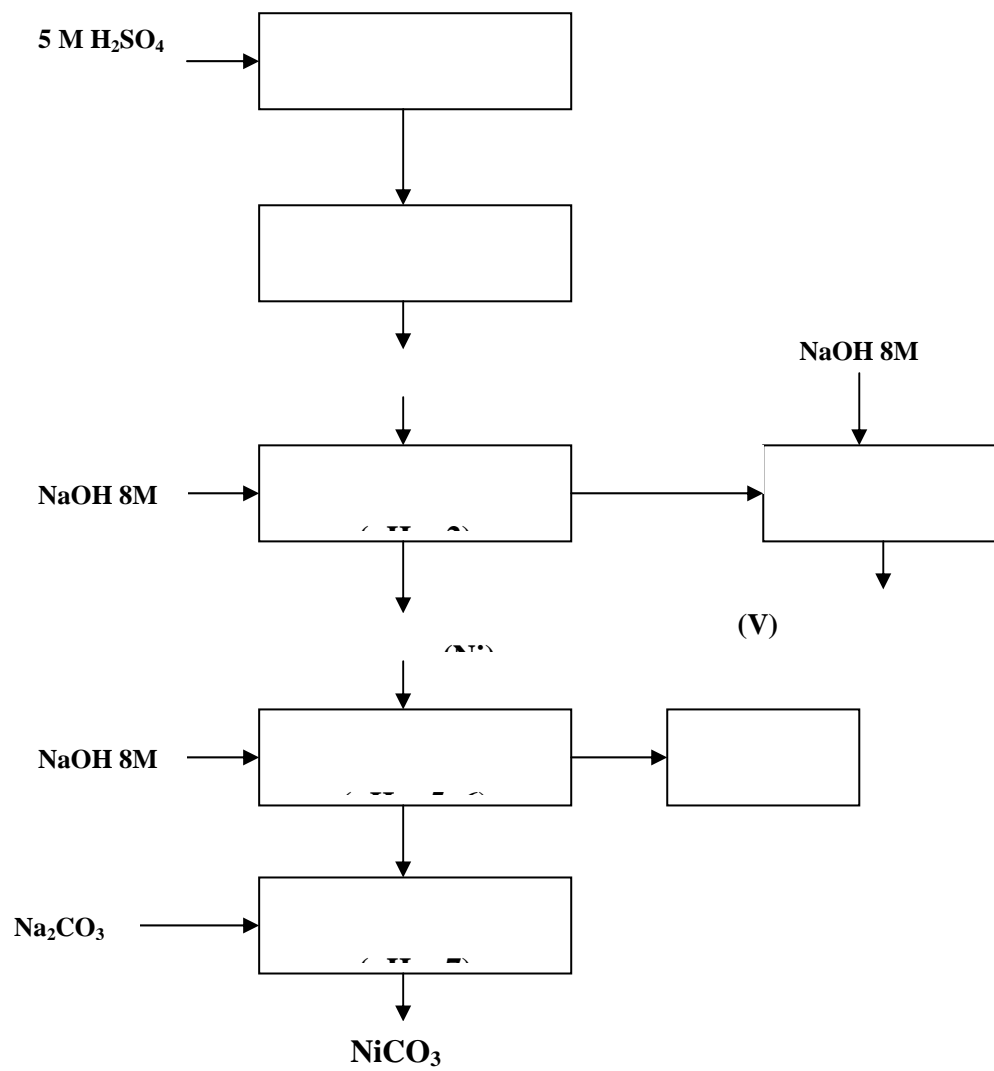
pH

.NiCO₃

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%

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:(10)

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% %

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