



Waste Management for Uranium Ore Processing in Nuclear Materials Authority, Egypt

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Objective

- To investigate the yellow cake precipitation from the liquid effluents produced from uranium ore processing pilot plant as a new approach for the liquid waste management at Nuclear Materials Authority, in order to avoid the environment pollution.

OUTLINE

- I. Uranium Resources in Egypt.
- II. Gattar Uranium Ore Processing Pilot Plant.
- III. Waste Effluents produced from NORM & TENORM at Gattar Site.
- IV. Liquid Waste Management.

Uranium Resources in Egypt

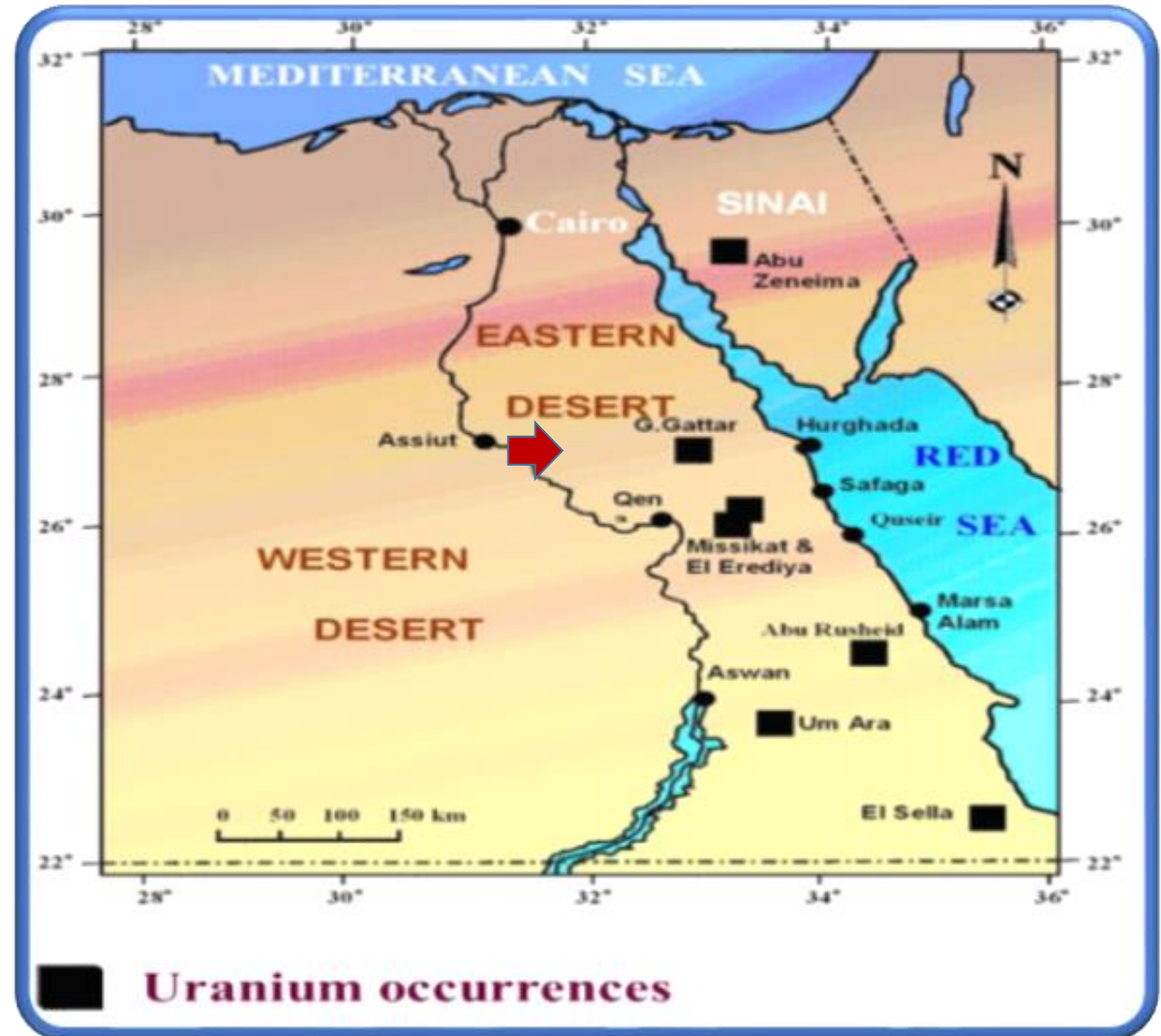
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graph TD; A[Uranium Resources in Egypt] --> B[Conventional Resources]; A --> C[Non Conventional Resources];
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Conventional
Resources

Non Conventional
Resources

Conventional Uranium Resources

- I. Gabal Gattar Prospect
- II. Abu Zenema Prospect
- III. El Missikat Prospect
- IV. Abu Rusheid Prospect
- V. Sela Prospect

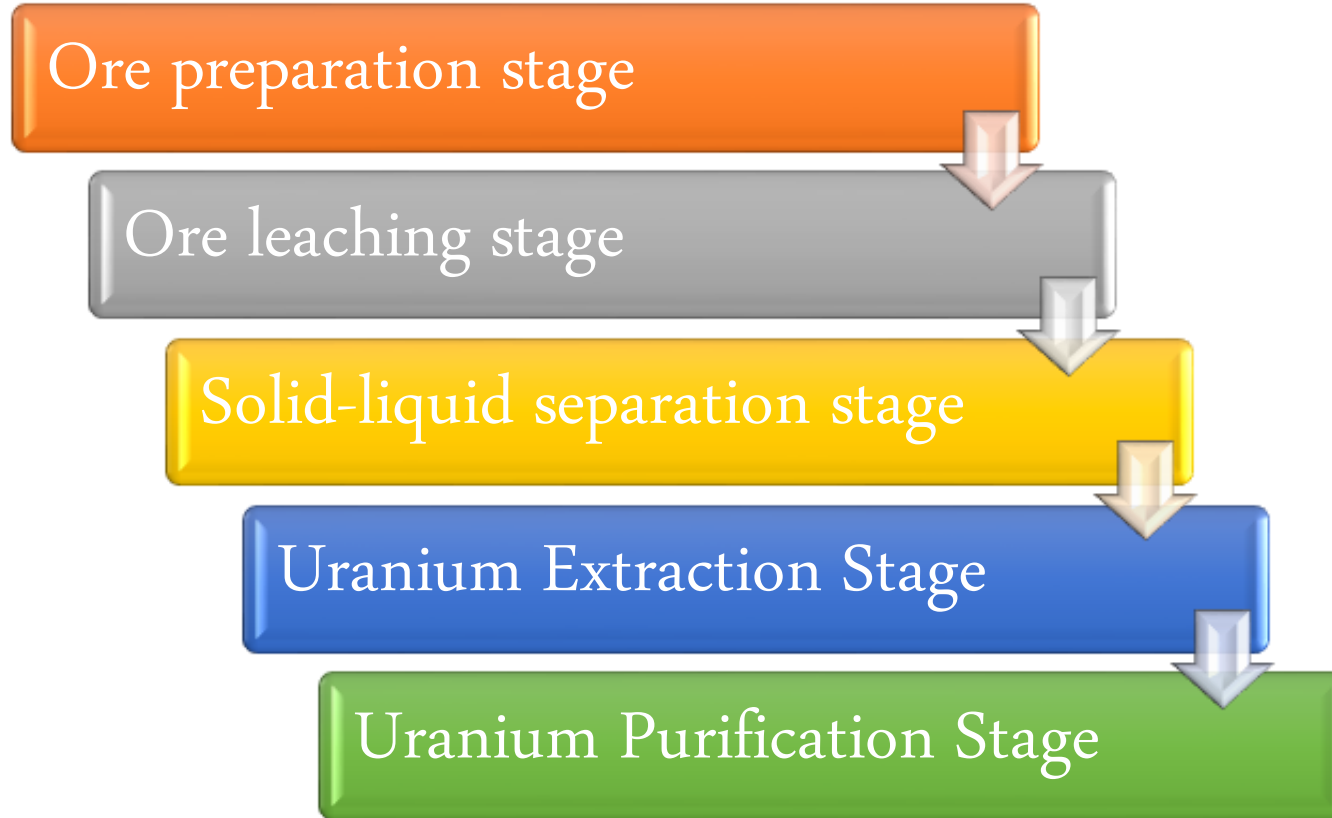


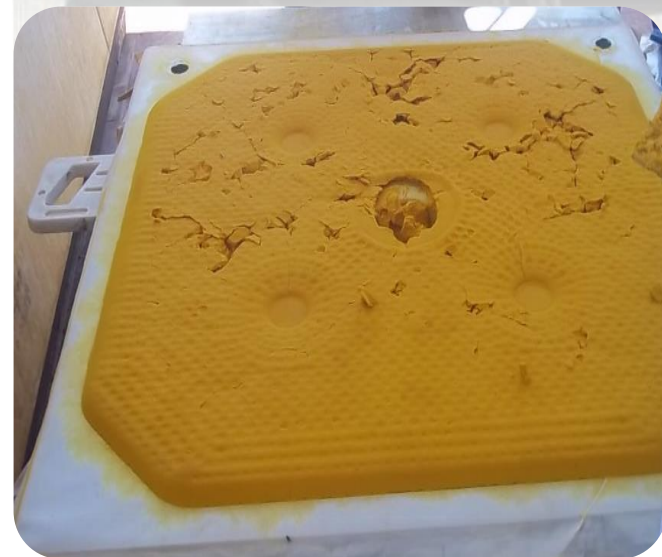
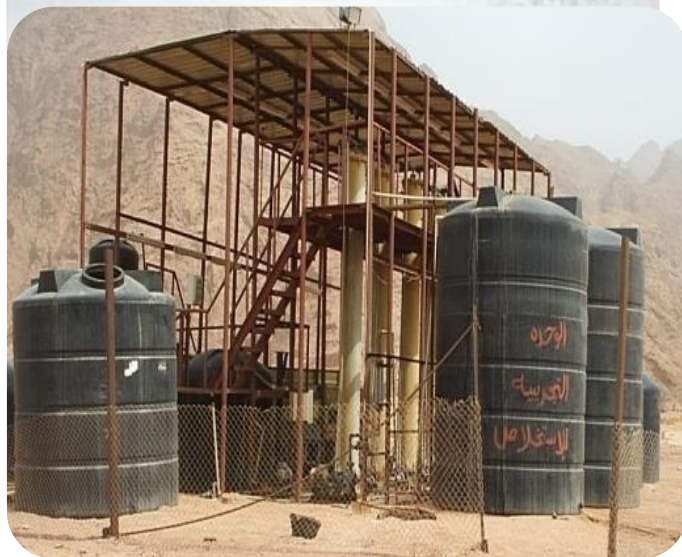
Non Conventional Uranium Resources

- Phosphate Rocks
- Black Sand



Gattar Uranium Ore Processing Pilot Plant





Waste Effluents produced from NORM & TENORM at Gattar site

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graph TD; A[Waste Effluents produced from NORM & TENORM at Gattar site] --> B[Solid waste]; A --> C[Liquid waste]
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Solid waste

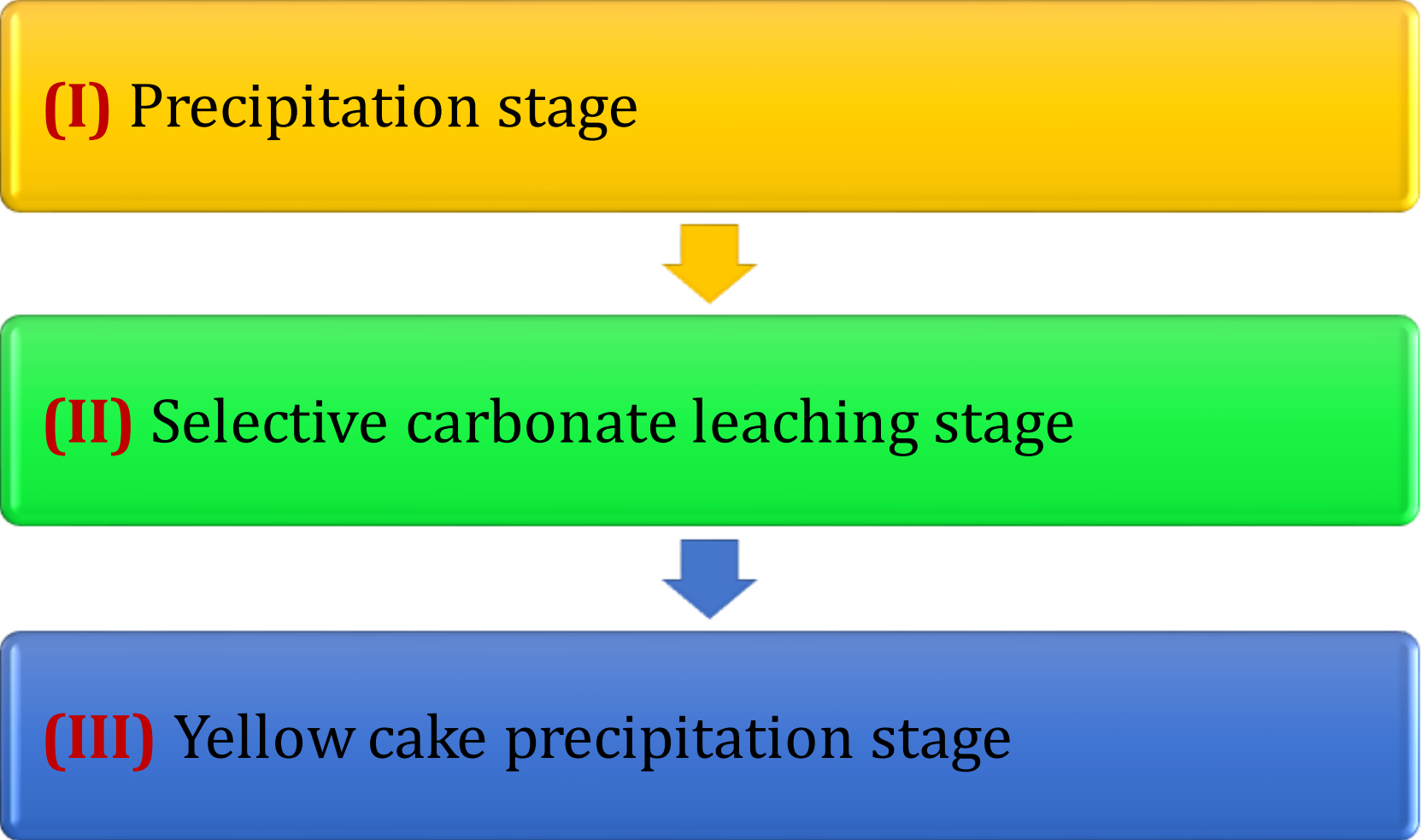
- The source of the solid wastes could be:
 - The mining process.
 - The leaching residue.
- NMA has to pay more attention for the waste management of the mining wastes and the solid residues.

Liquid waste

- The source of the liquid wastes could be:
 - Washing,
 - Scrubbing,
 - Raffinate,
 - Solvent regeneration solutions.

Liquid Waste Management:

Liquid waste management has been achieved through the following stages;



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graph TD; A["(I) Precipitation stage"] --> B["(II) Selective carbonate leaching stage"]; B --> C["(III) Yellow cake precipitation stage"]
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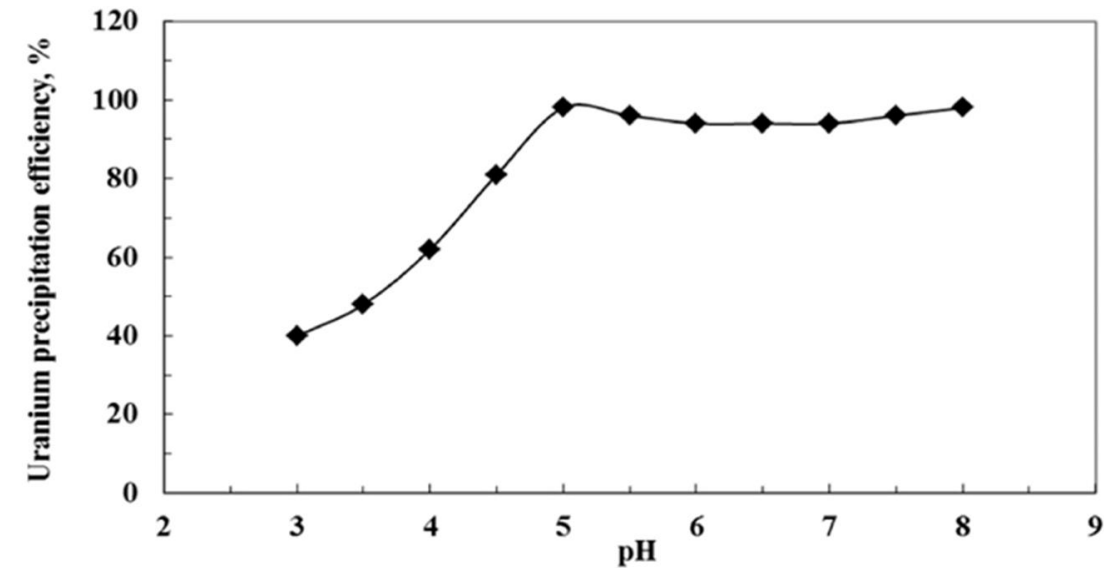
(I) Precipitation stage

(II) Selective carbonate leaching stage

(III) Yellow cake precipitation stage

(I) Precipitation stage:

- The objective of this stage is achieving the complete precipitation of uranium, dissolved salts as well as suspended solids in order to obtain friendly environmental effluents.
- In this concern, the liquid effluent sample was subjected to different pH values ranging from 3.0 to 8.0 using ammonium hydroxide to investigate the complete precipitation.
- pH 5 was found to be satisfied to precipitate about 98% of the uranium content as well as the dissolved salts, and suspended solids.



Raffinate Precipitation Using Ammonium Hydroxide

Chemical Analysis of Heavy Metals and trace elements for the Precipitated Cake by (ICP-OES)

Element	Conc., %	Element	Conc., %
U	1.25	Mo	0.77
As	0.49	Si	1.54
Cd	0.05	Co	0.68
Cs	0.15	Ti	1.04
Pb	0.86	W	0.07
Sr	0.24	Er	2.9
Zn	5.11	Gd	0.5
Cu	9.07	Lu	0.01
Cr	3.67	Tm	0.28
Al	7.35	Yb	0.18
V	1.77	Y	0.13
Na	5.24	Pr	2.97
K	4.18	Sm	0.39
Ca	2.88	Ni	1.83
Mg	3.11	Mn	1.31
Fe	13.12	Ba	1.23



(II) Selective carbonate leaching stage:

- The objective of this stage is selective leaching of uranium from the obtained precipitate cake in order to add value to the proposed liquid effluent waste management approach.
- Generally alkaline leaching is often applied for uranium leaching if the ore contains more than 12% of carbonates. However, carbonate leaching process is highly selective and often reduces the impurities content that have to be removed in the downstream processes.
- In this concern, the obtained precipitate cake was contacted with sodium carbonate solution (30 g/L) for 4 hours at reaction temperature of 90 °C.
- About 95% of the uranium content in the precipitate cake has been successfully leached using sodium carbonate.



Carbonate leaching



Solid/ liquid separation



Solid residue

(III) Yellow cake precipitation stage:

- The objective of this stage is the uranium precipitation as yellow cake from the obtained leach solution.
- Hydrogen peroxide has been used as a precipitating agent, owing to its superior selectivity towards uranyl ion.
- Accordingly, hydrogen peroxide is added to the obtained uranyl carbonate solution after the adjustment of its pH to precipitate uranium as uranium peroxide. The required stoichiometric amount of hydrogen peroxide (50% Conc.) should not be less than 100% excess.
- The yellow cake was dried at a moderate temperature of about 110 °C for 24 hours.

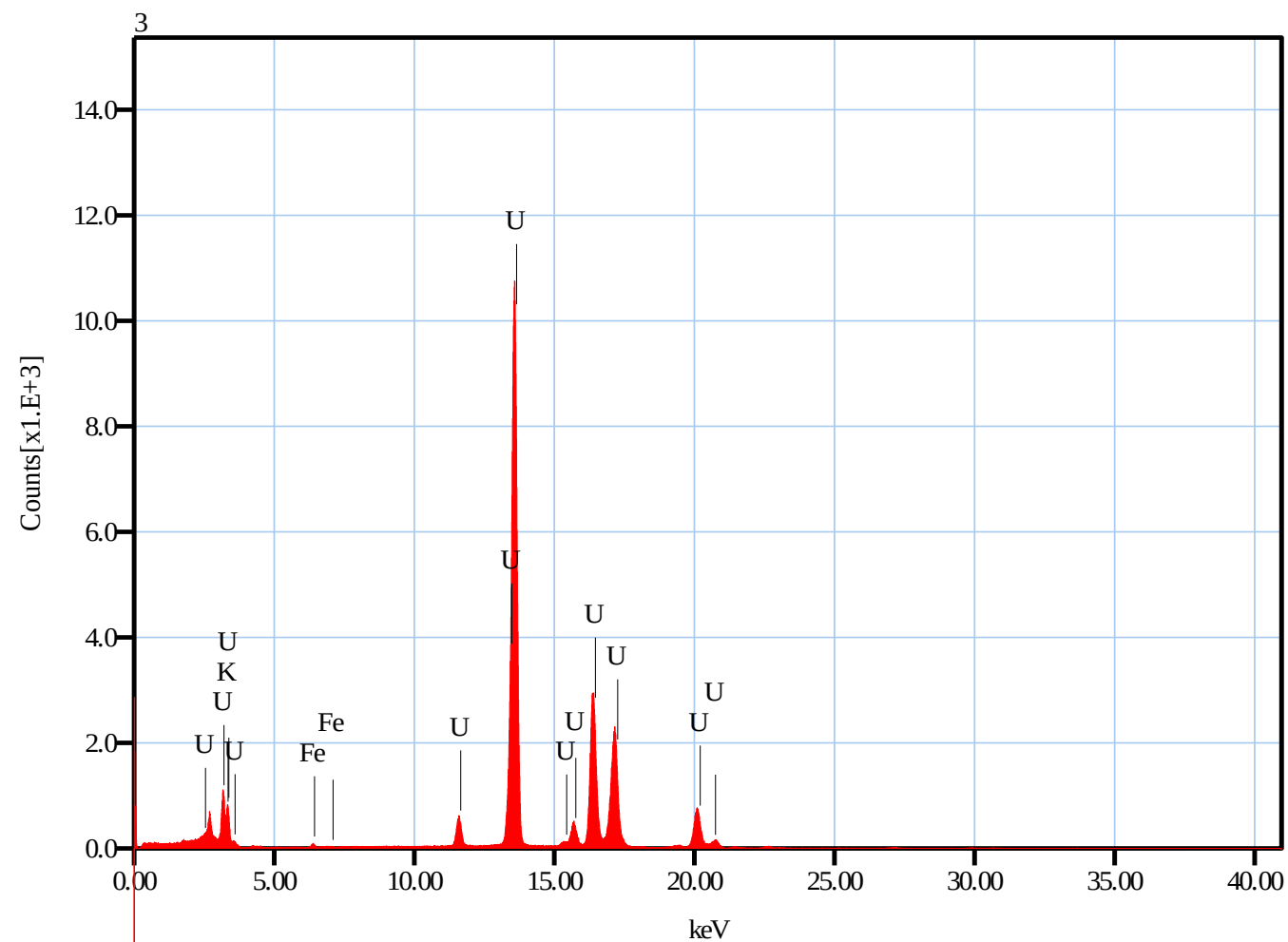


Uranium precipitation process



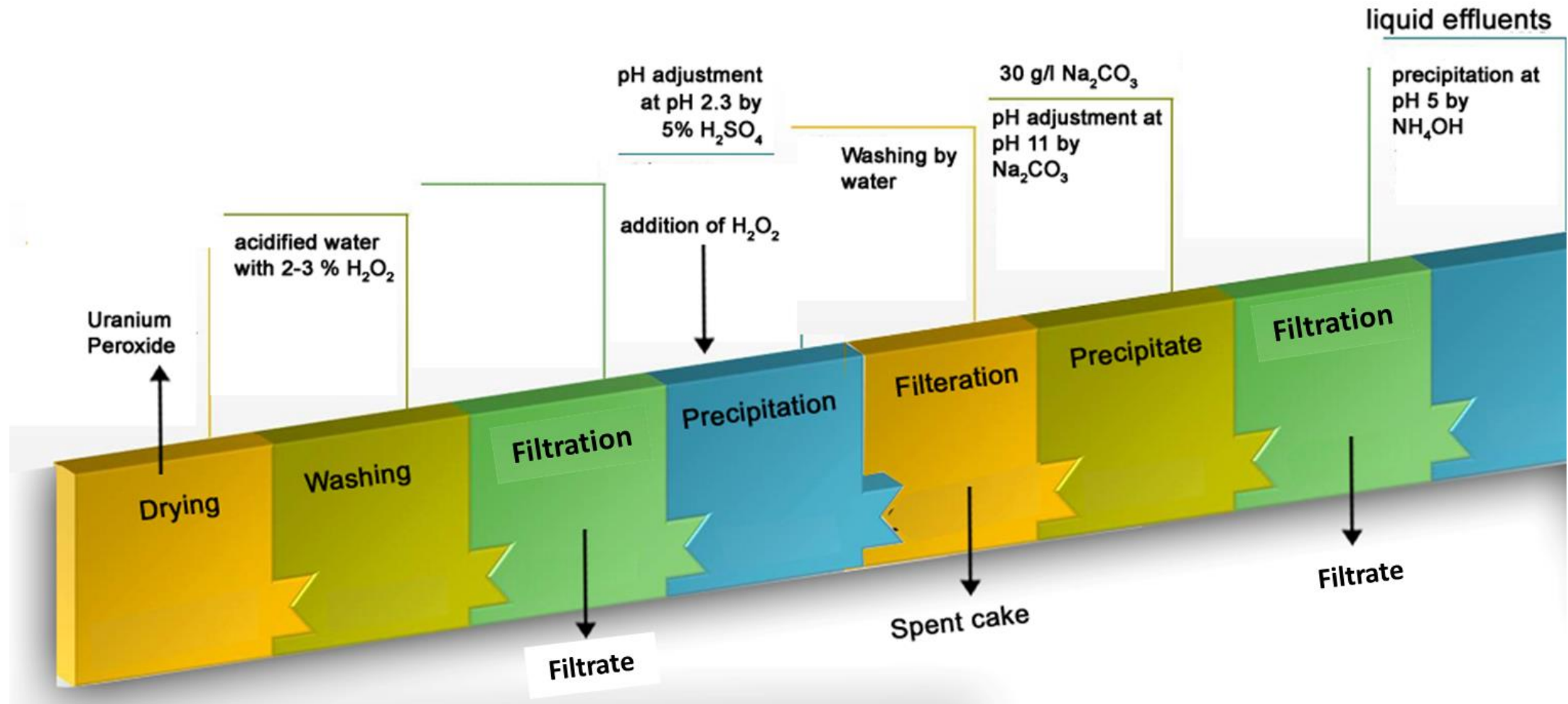
The obtained yellow cake product

XRF analysis for the obtained uranium product



Element	Conc., %
U	60.5
As	0.002
Cd	0.002
Cs	0.02
Pb	0.02
Sr	0.003
Zn	0.007
Cu	0.002
Na	0.09
K	0.008
Ca	0.05
Mg	0.003
Fe	0.09
Ni	0.002
Mn	0.007
Co	0.005
B	ND
Ti	0.01

Proposed Flow Diagram for the treatment of the Effluent Liquid Solutions



Conclusion

- The waste management for the liquid effluent that produced from Gattar uranium ore processing pilot plant has been achieved through the following stages: **(1)** Precipitation using sodium hydroxide, **(2)** uranium selective leaching using sodium carbonate, and **(3)** uranium oxide precipitation using hydrogen peroxide. About 93% of the raffinate uranium content has been recovered by applying the suggested flow diagram.
- According to the proposed liquid effluent waste management approach, a friendly environmentally liquid effluent has been obtained. In addition, yellow cake has been produced as an added value to the proposed approach.

For your Kind
Attention

