Apatites based Nanoceramics: Cobalt based waste water treatment

Dr. Rajendra S. Khairnar

School of Physical Sciences,

S.R.T.M. University, Nanded-431606

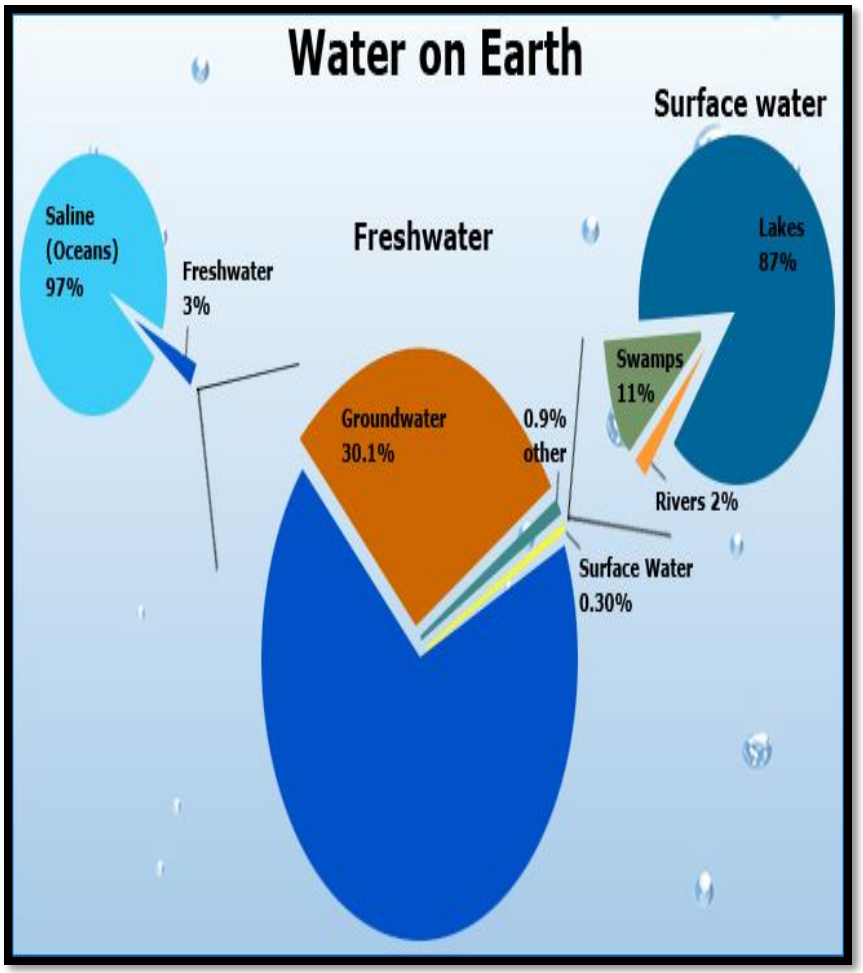
Maharashtra, INDIA.

Contents

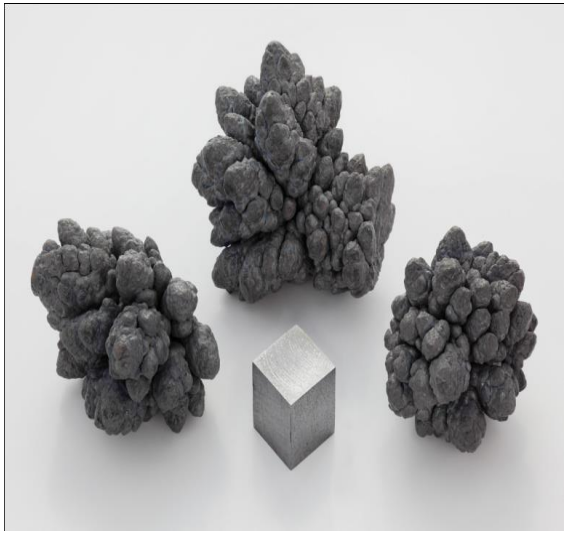
- Introduction
- Apatites
- Hydroxyapatite (HAp)
- Applicability of HAp for cobalt adsorption
- Results
- Conclusion

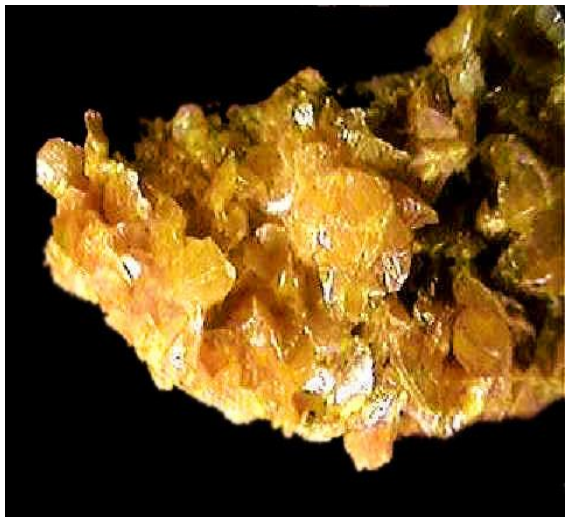
Blue planet

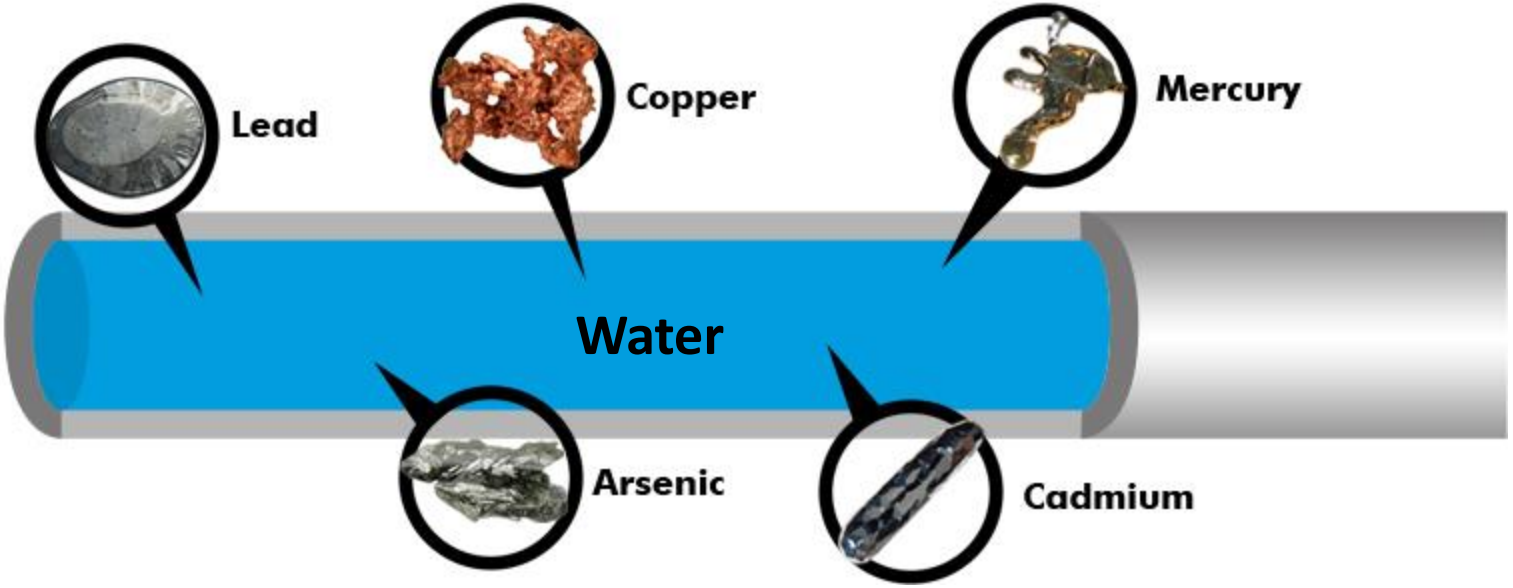

LAND AREA
29,1%
WATER AREA
70,9%
shutterstock
www.shutterstock.com · 118176220


Water on Earth
Saline (Oceans) 97%
Freshwater 3%
Freshwater
Surface water
Lakes 87%
Swamps 11%
Rivers 2%
Groundwater 30.1%
0.9% other
Surface Water 0.30%

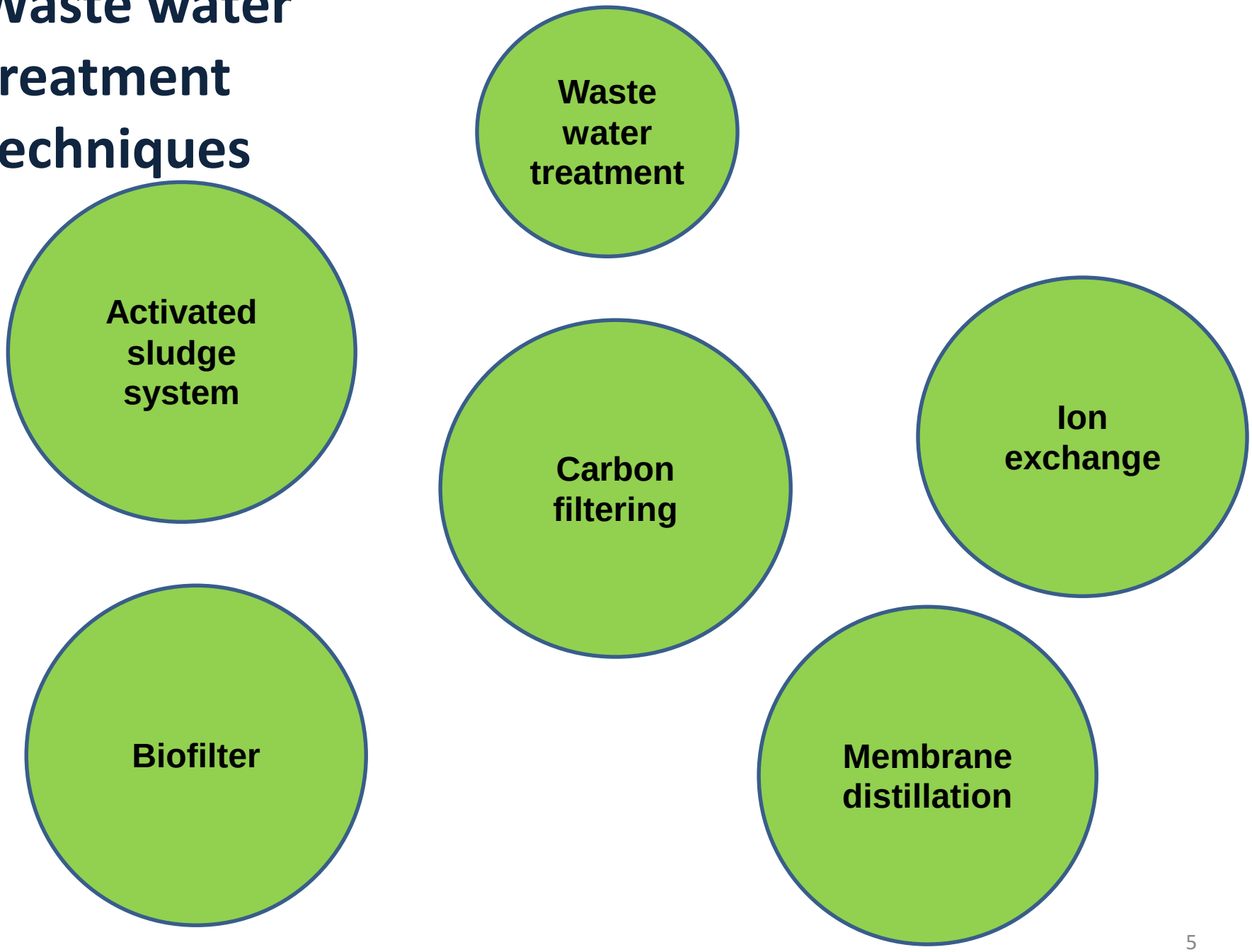
Heavy metals in water







Waste water treatment techniques



Apatites-Hydroxyapatite (HAp)

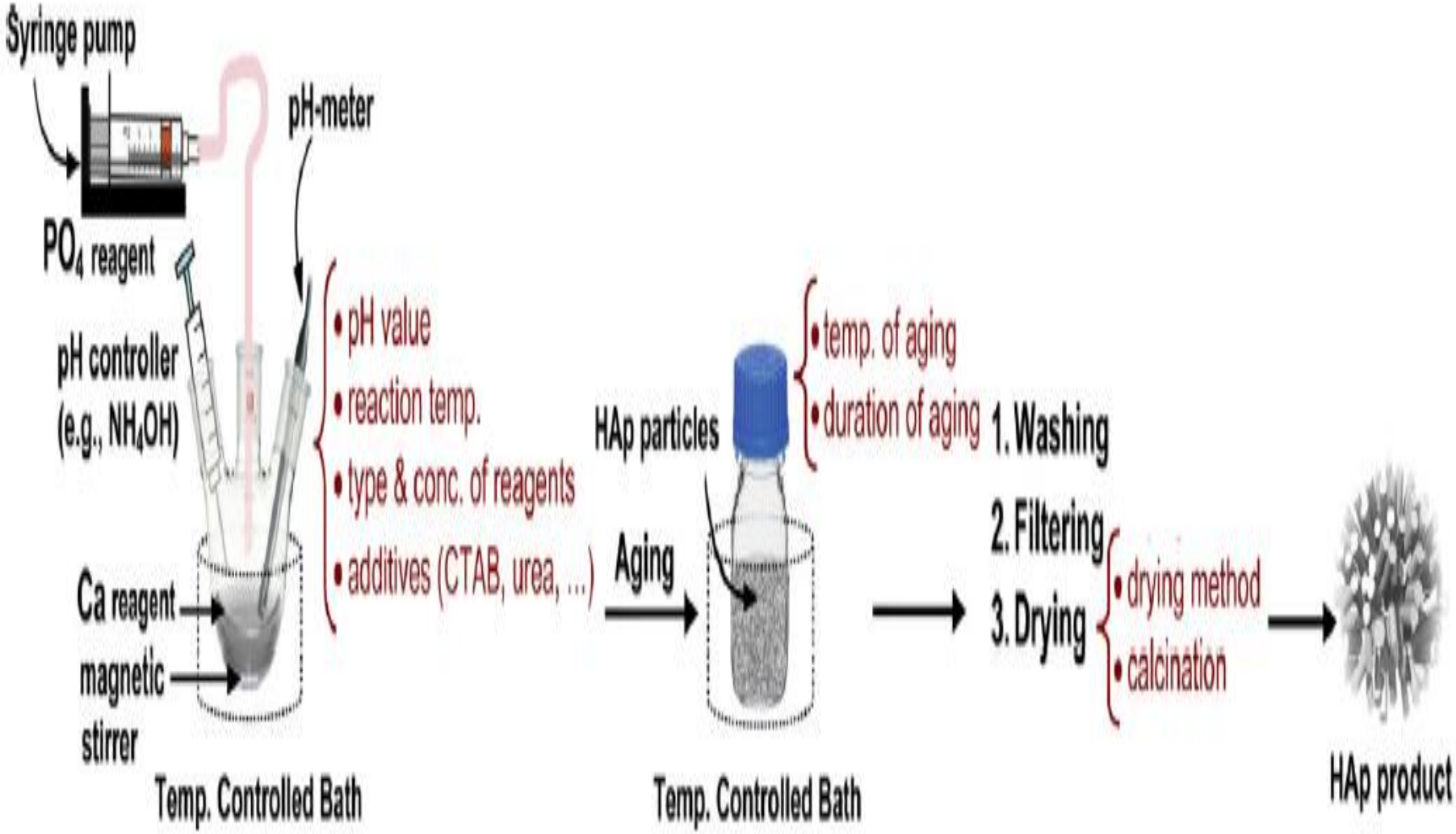
Properties of HAp

- Biocompatible
- Bioactive
- Non-toxic
- Non-inflammatory
- Good ionic conductivity
- Good adsorption capacity
- Large surface area

Application of HAp

- Purification of Biological molecules
- Catalyst
- biomaterial
- Gas-sensor
- Bioceramic Coatings

Synthesis of HAp



Characterizations

- AFM
- SEM
- XRD
- TG/DTA
- FTIR

AFM

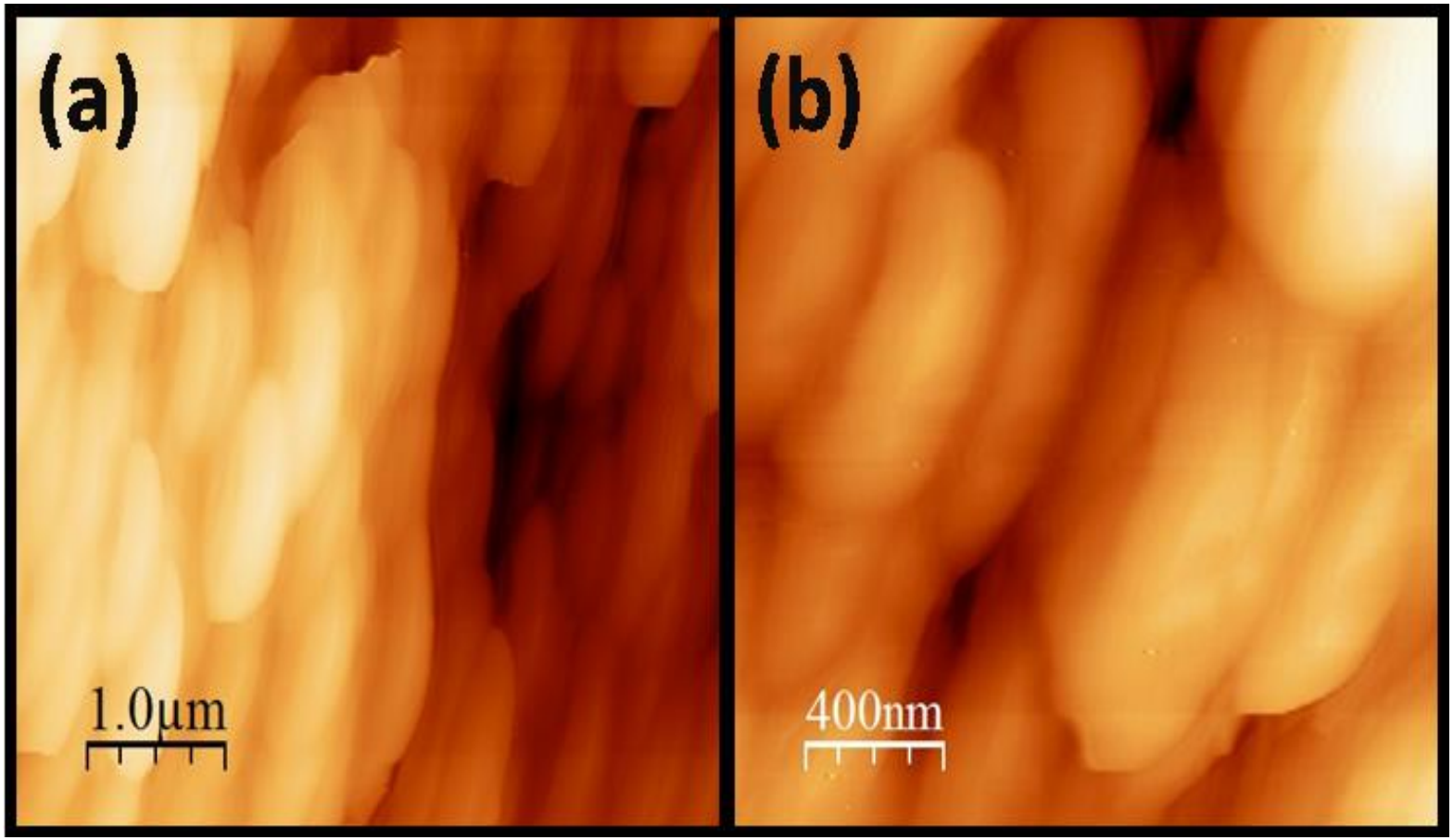


Figure- AFM images of HAp (a) 1 µm and (b) 400 nm

SEM

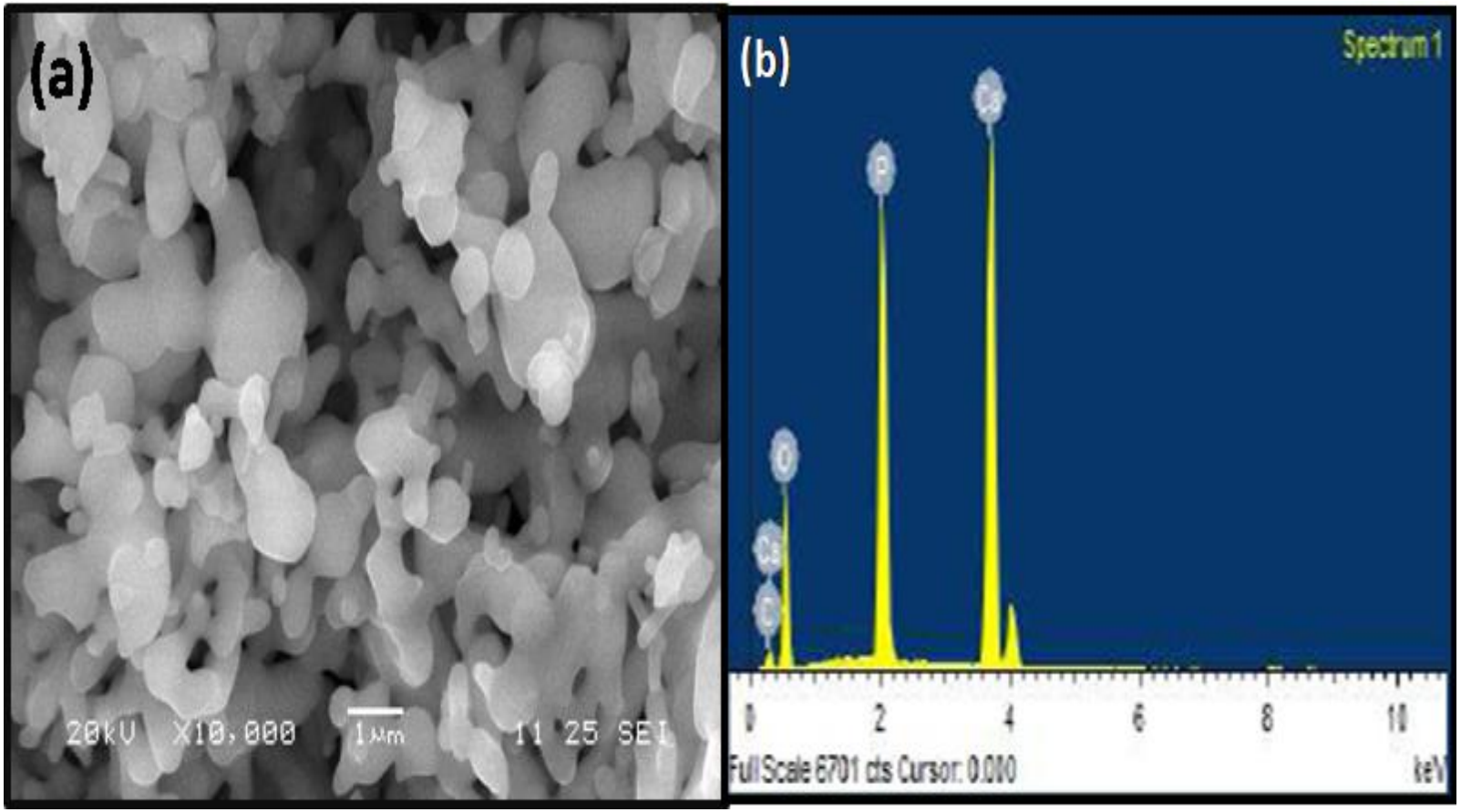


Figure- (a) SEM images of HAp (1 µm) and (b) EDS spectrum

XRD

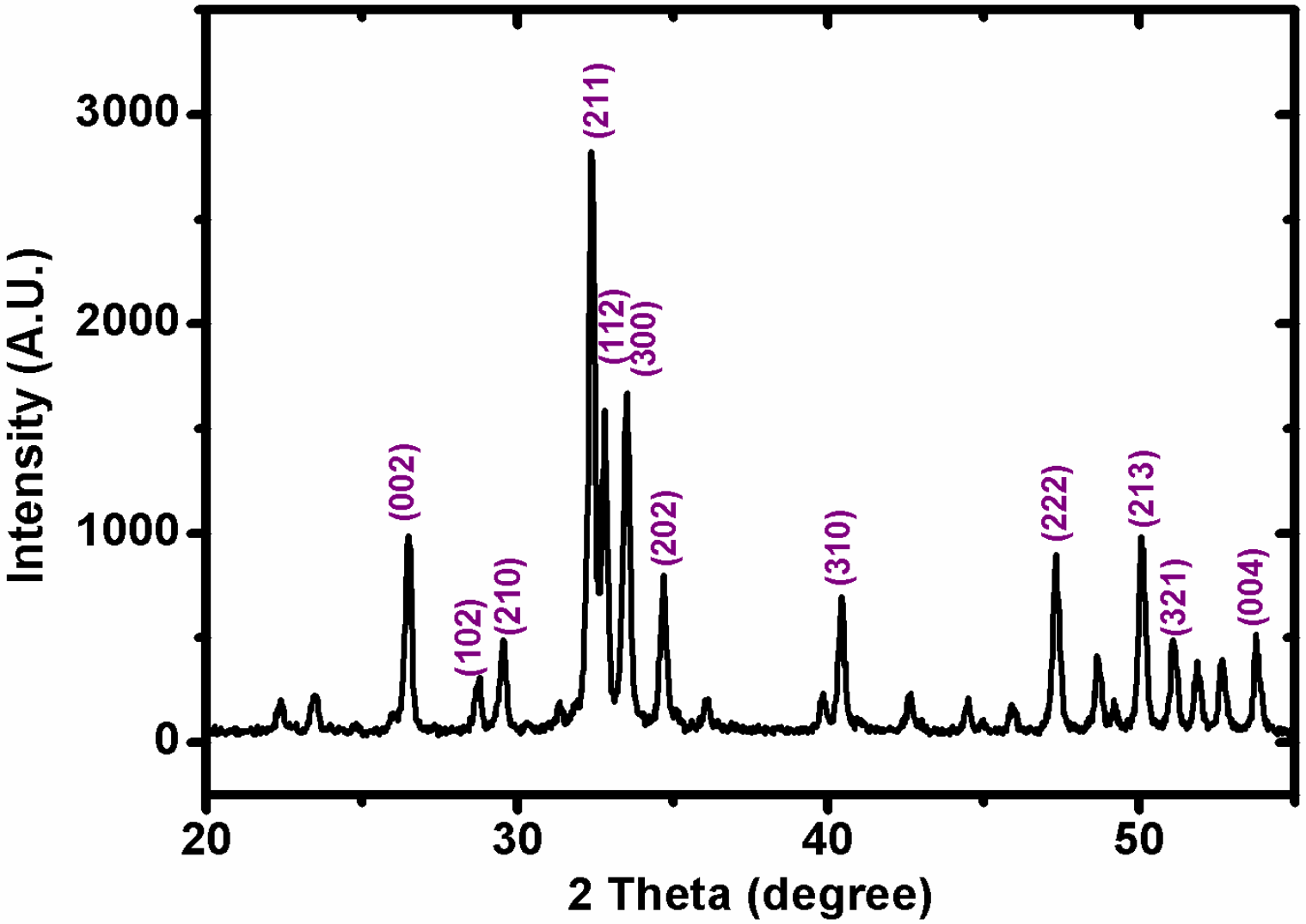


Figure- XRD pattern of HAp

TG/DTA

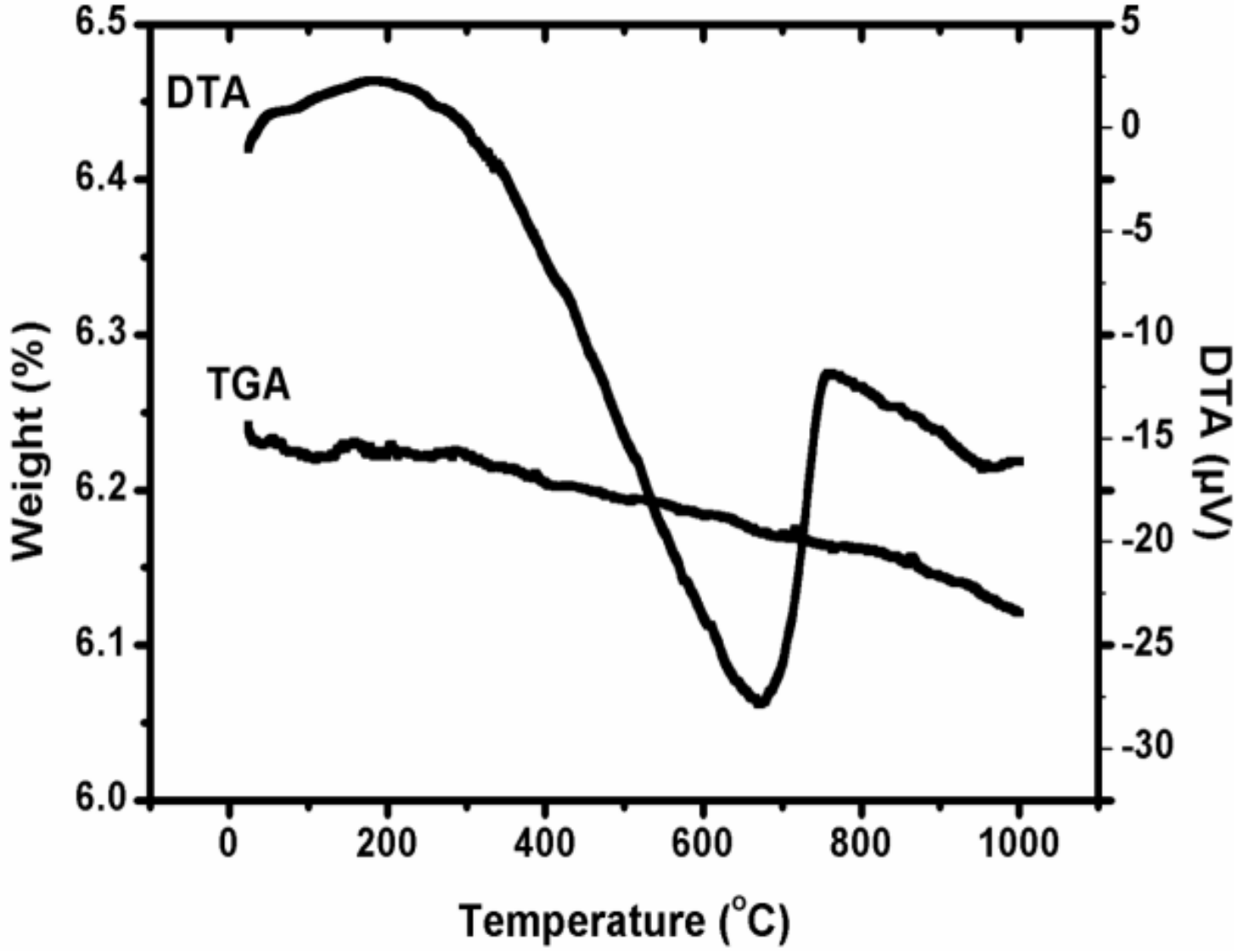


Figure- TG/DTA plot of HAp

Cobalt adsorption experiment

- Batch experiment study used
- The concentration of cobalt is determined using UV-Vis spectrometer @ 511 nm
- Formulae used

1) % Removal = [(Ci-Ce)/Ci]*100

2) Max. Adsorption capacity (mg/g) qe = (V/W) * (Ci-Ce)

Where, Ci –initial cobalt concentration (mg/l)
Ce-cobalt solution concentration after adsorption (mg/l)
V-Volume of cobalt solution (l)
W-Weight of HAp adsorbent (gm)

Experiments

- Effect of initial concentration
- Effect of HAp dosage
- Effect of contact time

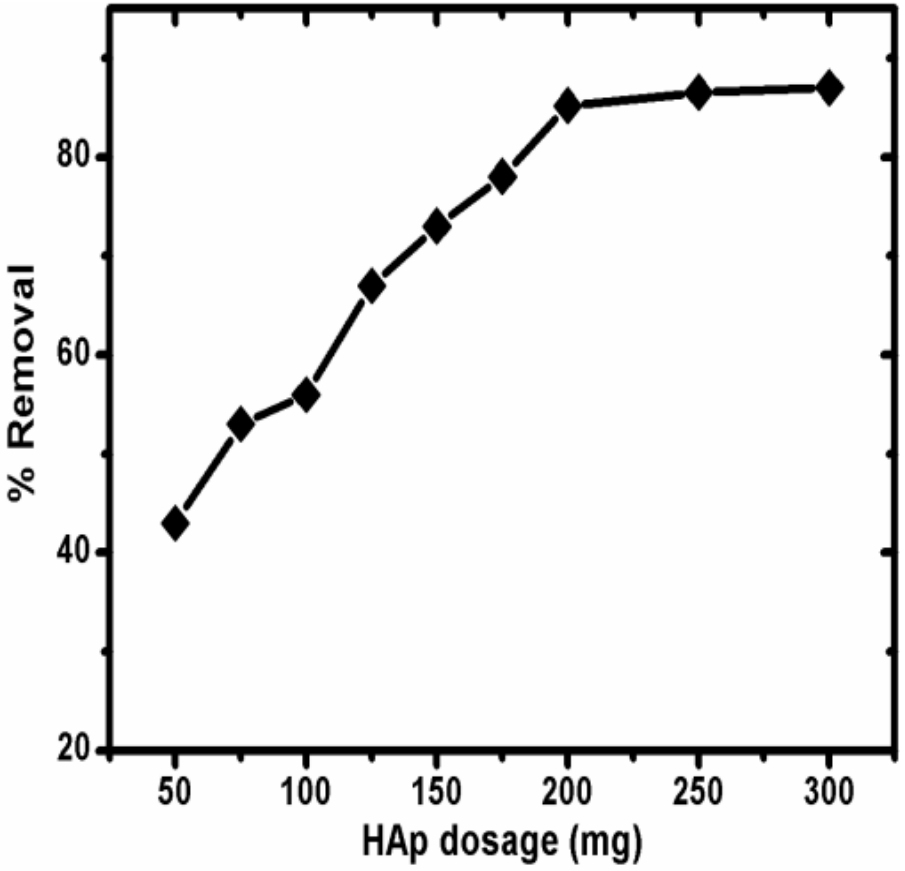


Figure-Effect of HAp dosage

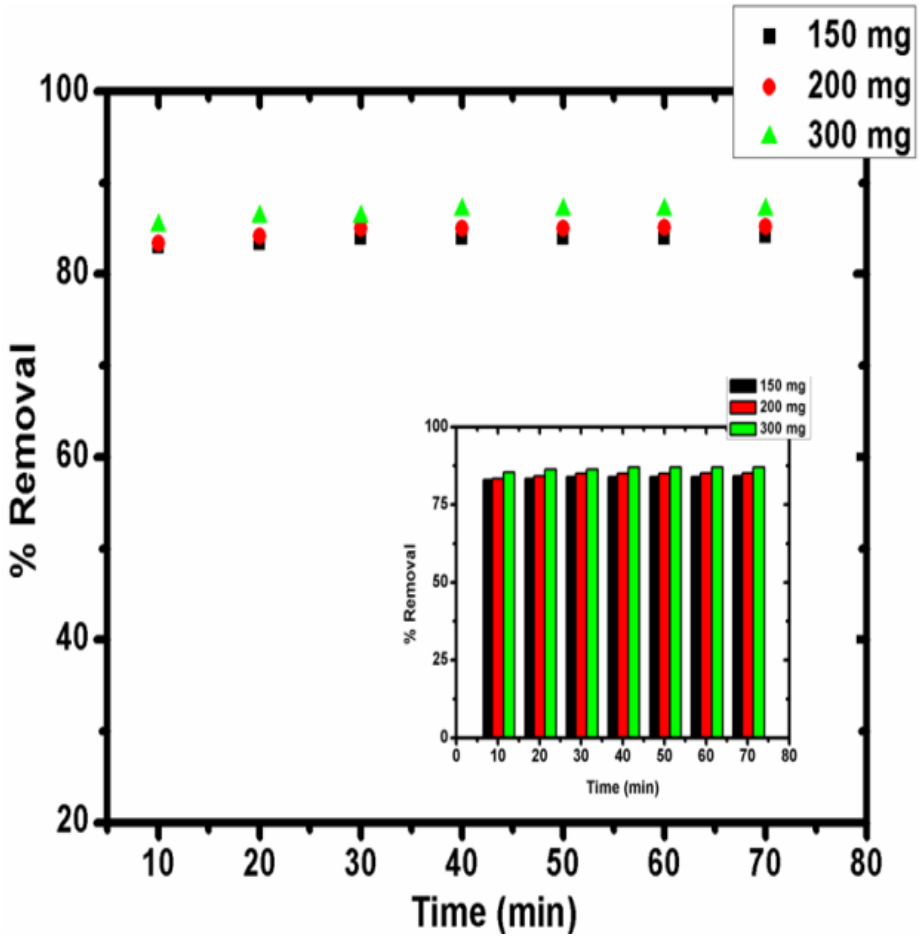


Figure-Effect of contact time

Post adsorption characterizations

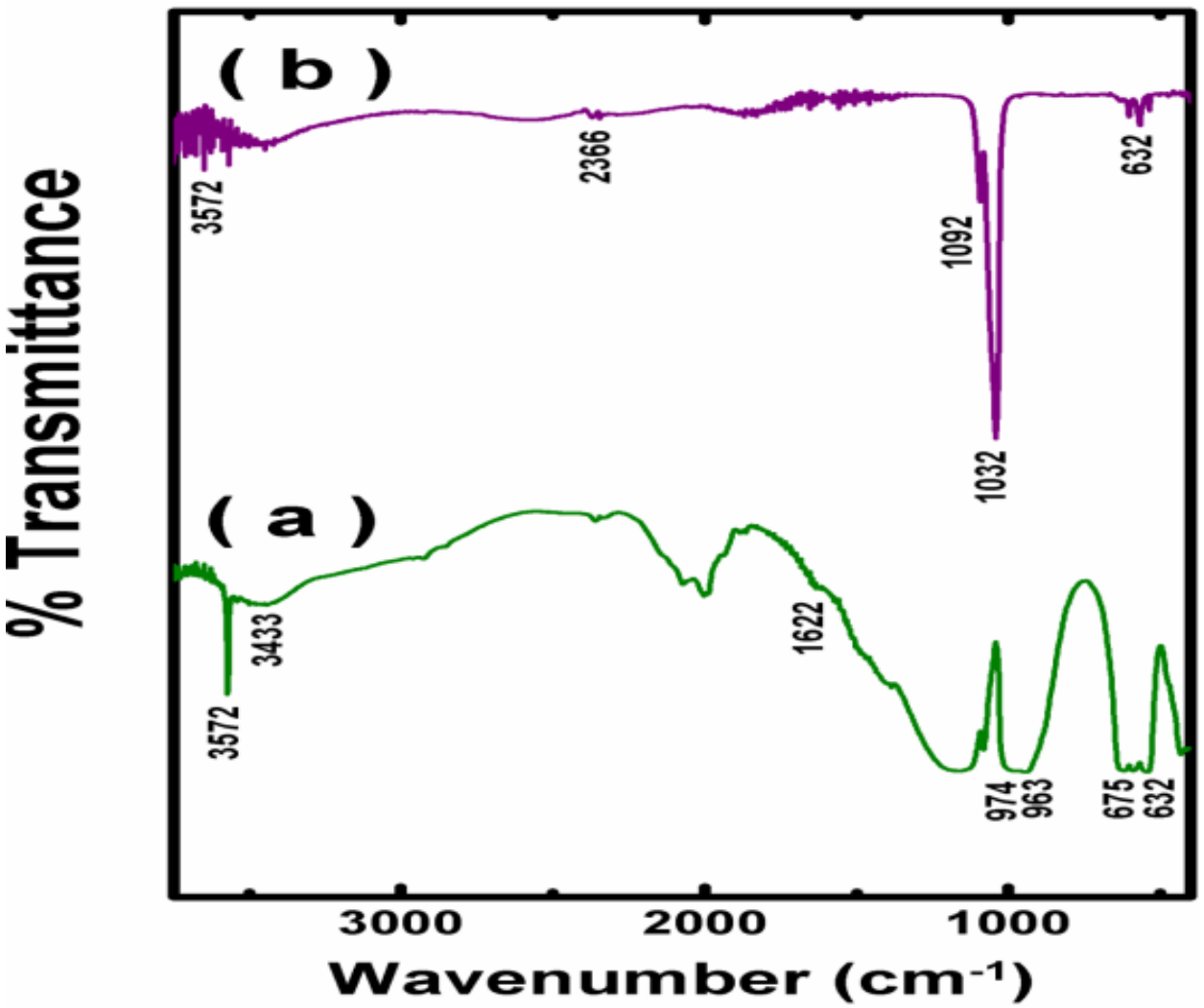


Figure -FTIR spectra of the (a) synthesized HAp nanopowder and (b) HAp after Co sorption

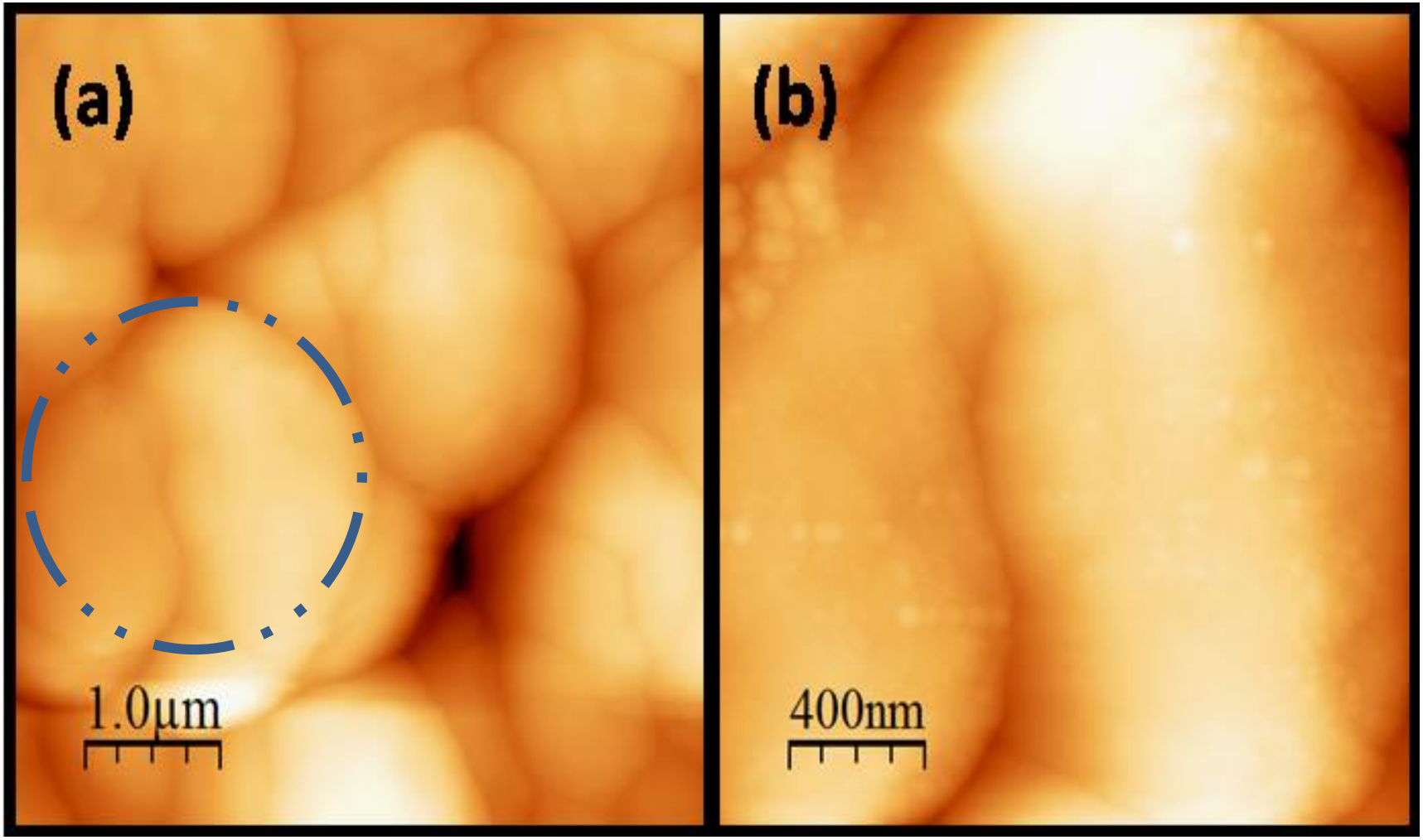


Figure- AFM of HAp after Co sorption at magnification (a) 1µm and (b) 400 nm

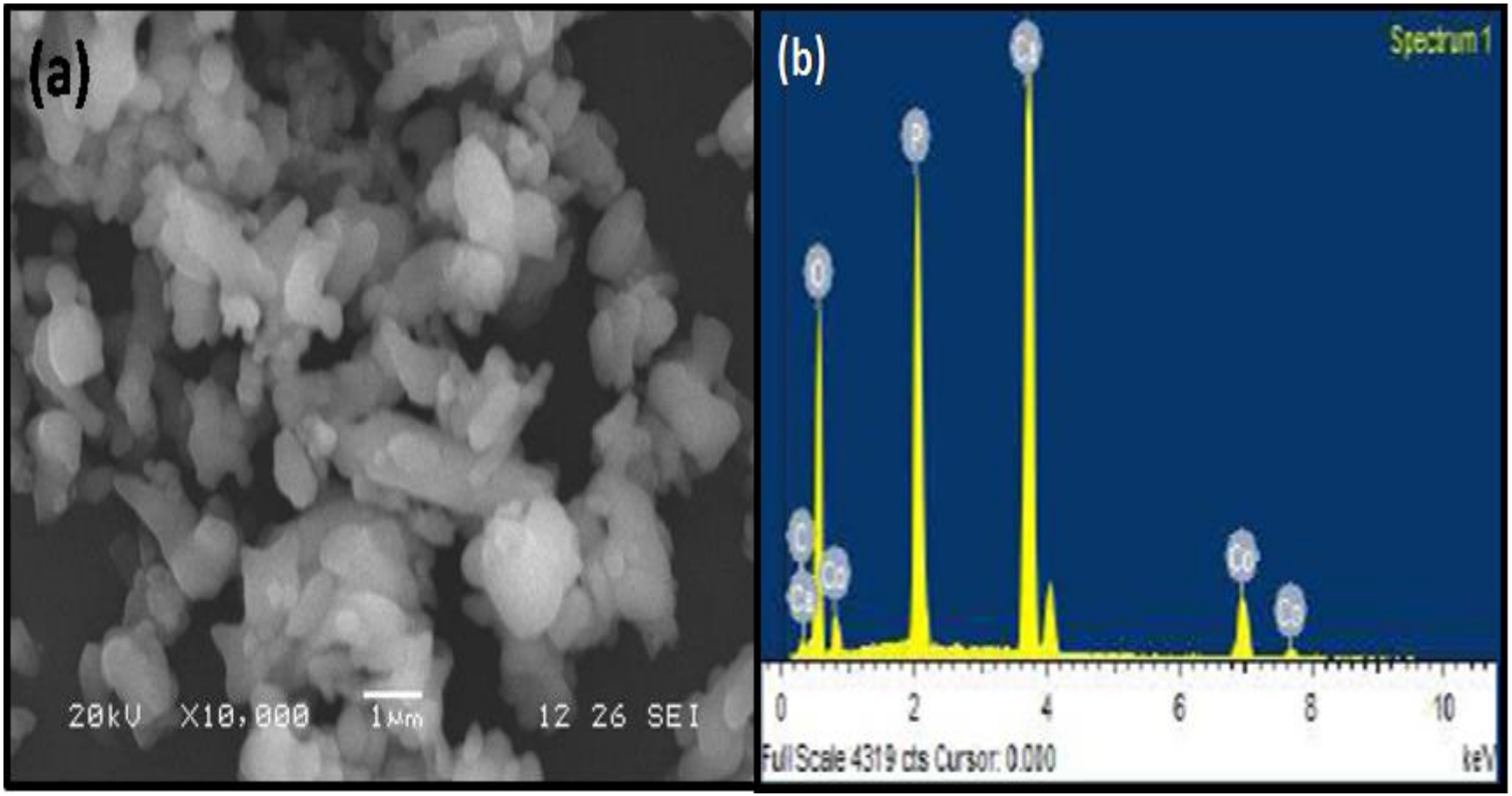


Figure - (a) SEM image and (b) EDAX spectra of HAp after Co sorption

Isotherm models

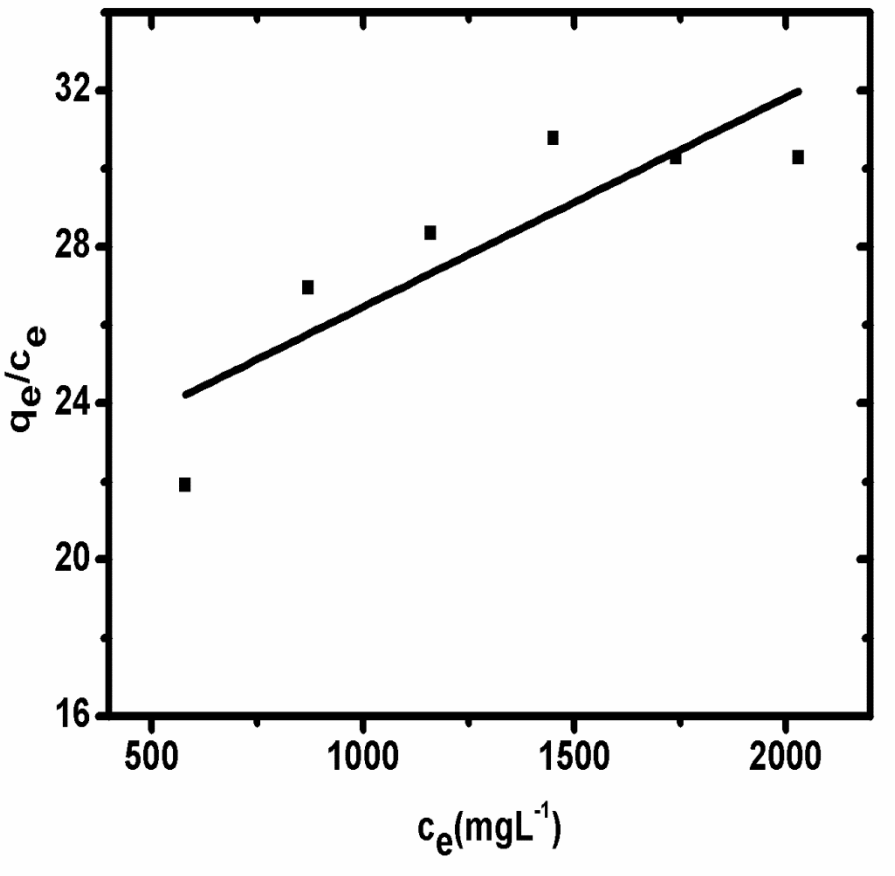


Figure-Langmuir isotherm

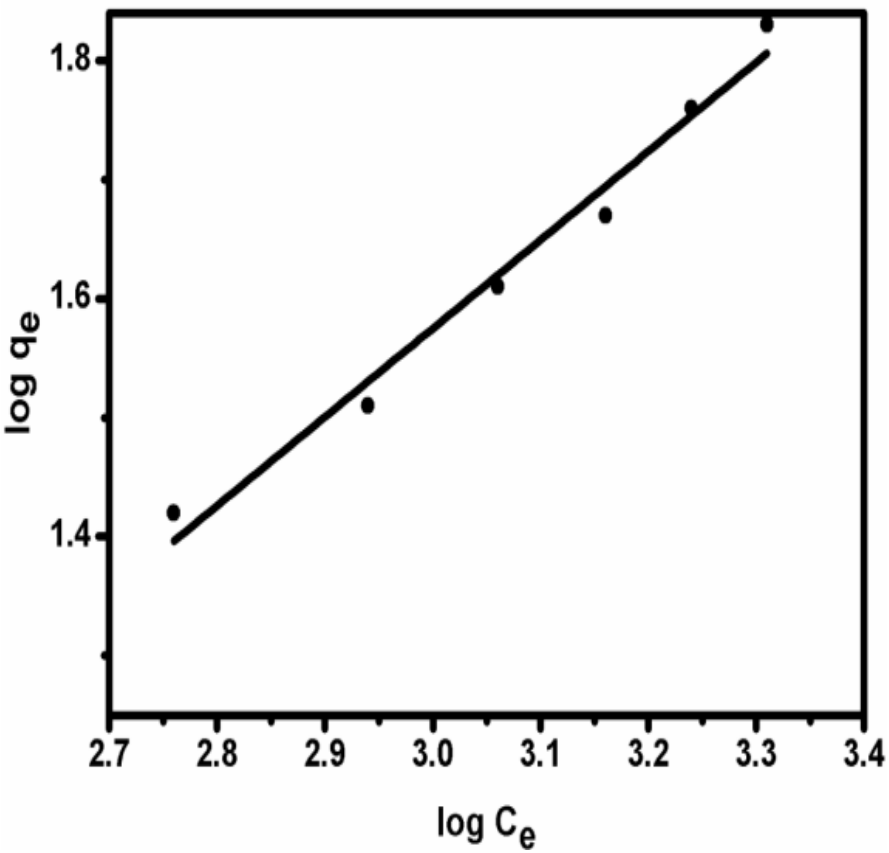


Figure- Freundlich isotherm

Kinetic models

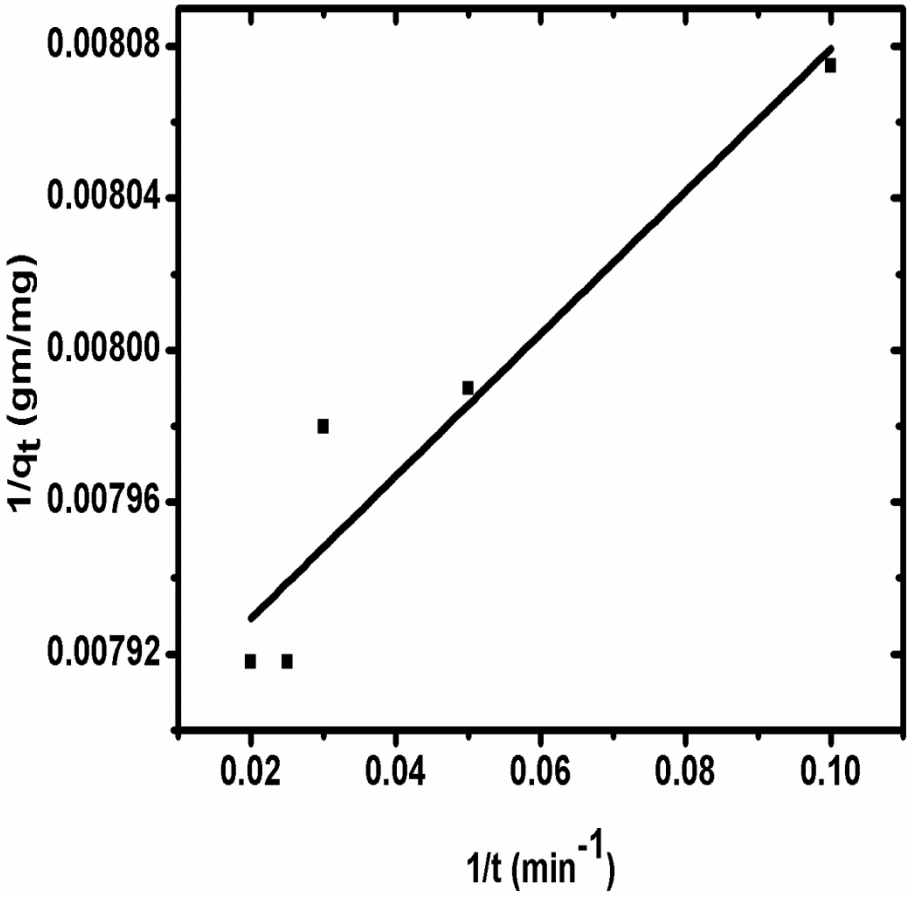


Figure-First order kinetic model

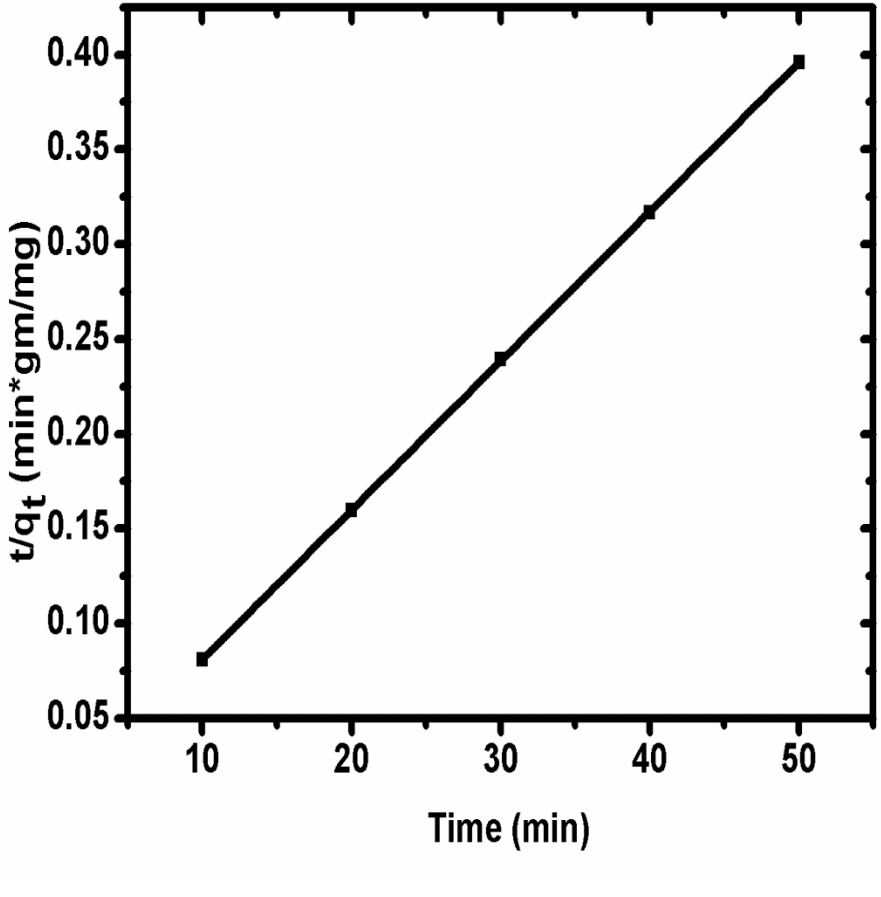


Figure-Second order kinetic model

Parameters of Isotherm

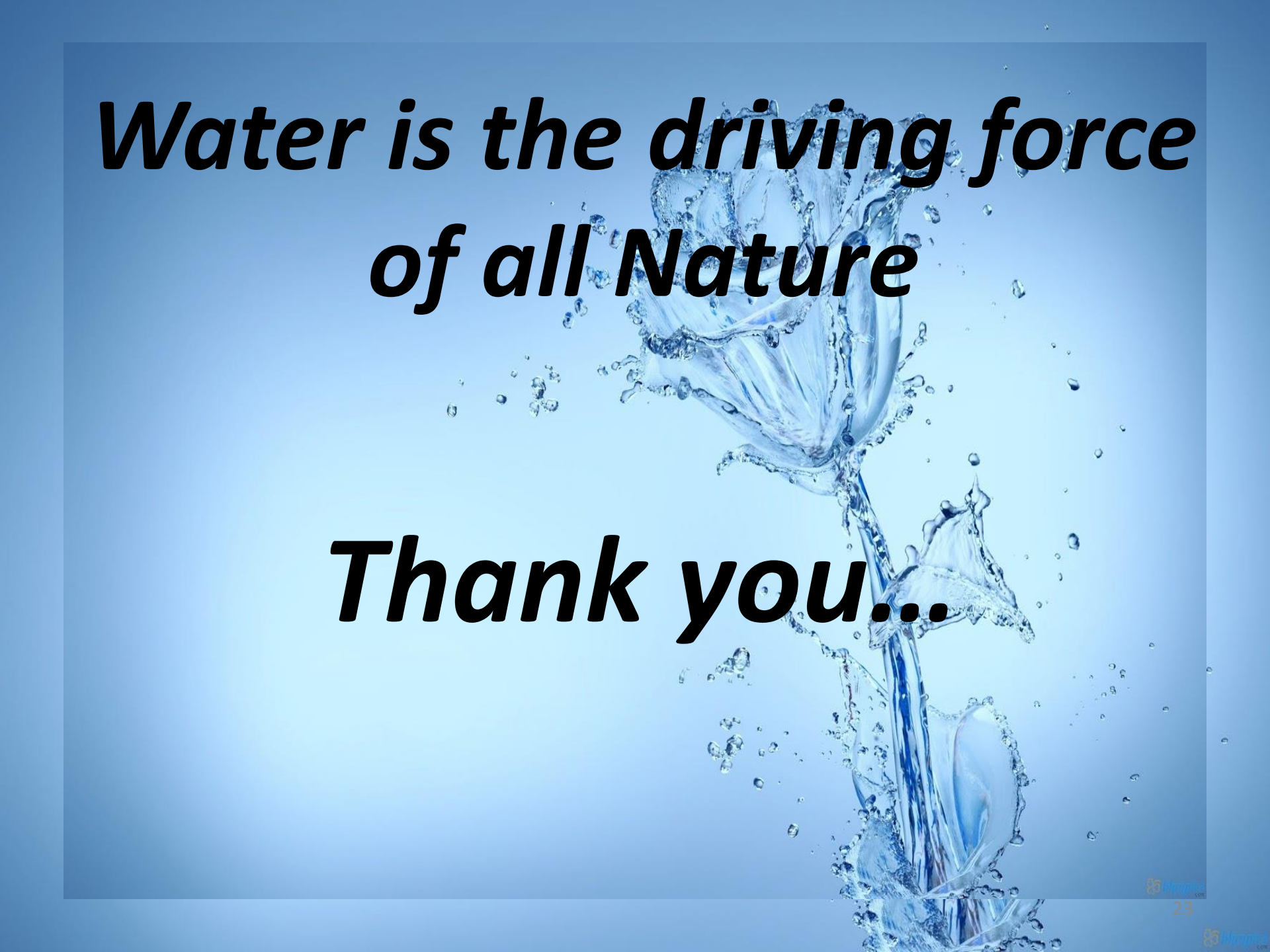
Langmuir isotherm			Freundlich isotherm		
q_0	b	R^2	k_f	1/n	R^2
1.21	0.000366	0.78	0.3019	0.6910	0.97

Parameters of Kinetic models

First order			Second order		
k_1	q_1	R^2	k_2	q_2	R^2
0.2382	126.74	0.87	0.02636	127.06	0.99

Conclusions

- The XRD analysis suggests the Hexagonal crystal structure of HAp.
- TGA/DTA shows the HAp is thermally stable up to 1000^0 C.
- The functional groups, Surface morphology and elemental analysis of HAp and Co-HAp are visualized by FTIR, AFM and SEM/EDAX respectively.
- Increase in the initial cobalt concentration and contact time increases the cobalt adsorption capacity.
- The kinetic data fitting results showed that the adsorption of cobalt on HAp is followed by pseudo second order kinetic model as the R^2 value equal to 0.99.
- The adsorption process is very fast, it attains the equilibrium in nearly 30 min.
- The max. Adsorption capacity is 1.21 mg/gm.


Water is the driving force of all Nature
Thank you...