

Zeolite Granulation: *Study of the interaction between Polymer and Zeolite 13X*

Polyacrylic acid(PAA), Polyethylene glycol(PEG) and Polyvinyl alcohol (PVA)

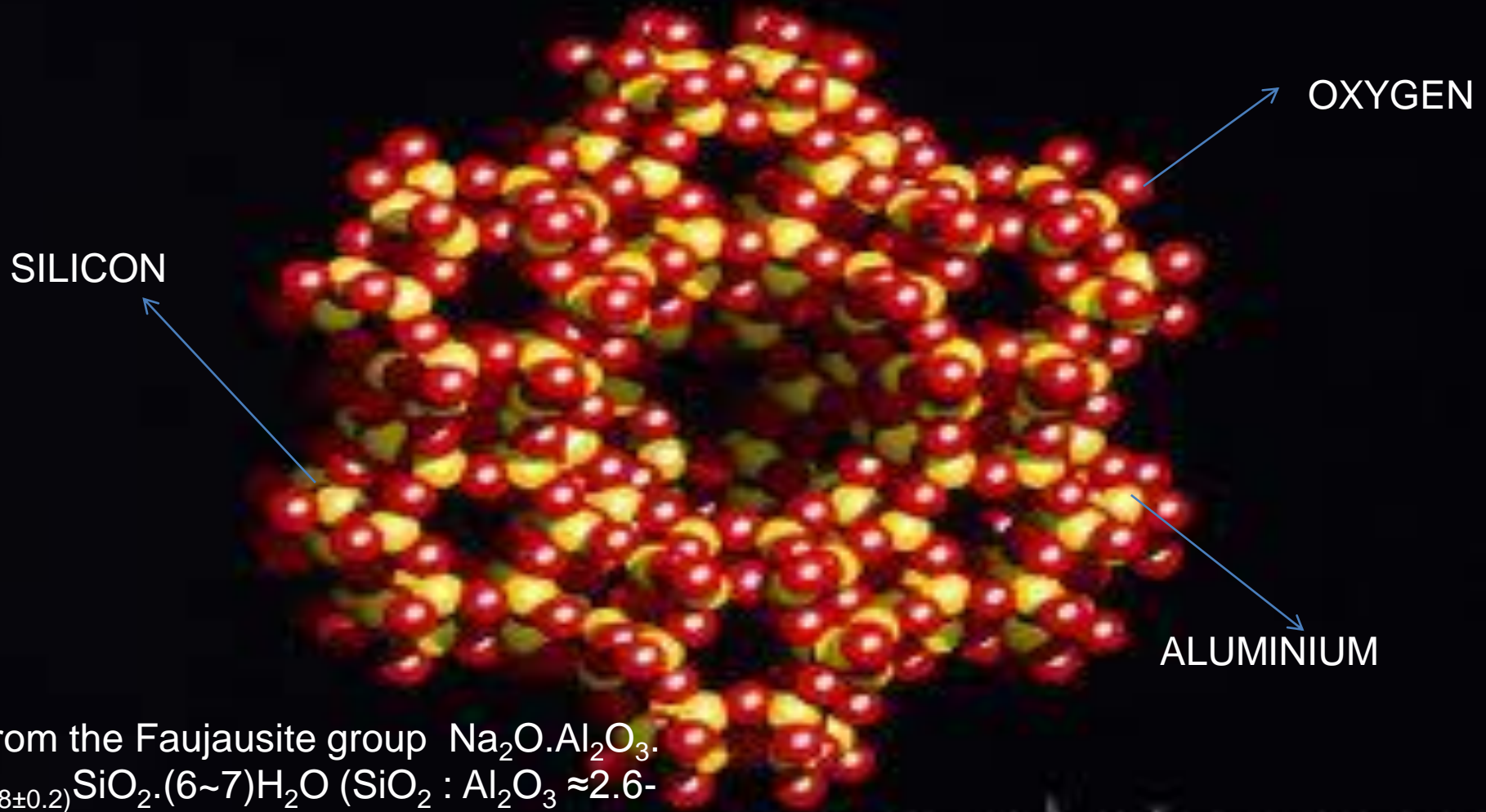
Presenter: Rochelle Lawrence
Supervisor: Zhe Zhao, Keith Duncan



ZEOLITE13X



ZEOLITE13X



From the Faujasite group $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot$
 $(2.8 \pm 0.2) \text{SiO}_2 \cdot (6 \sim 7) \text{H}_2\text{O}$ ($\text{SiO}_2 : \text{Al}_2\text{O}_3 \approx 2.6$ -
 3.0)

SCIENCEPHOTOLIBRARY



ZEOLITE13X- Application

- ✘ Removal of CO₂ and moisture from air (air pre-purification) and other gases.
- ✘ Separation of enriched oxygen from air.
- ✘ Desiccant for medical and air compressor systems
- ✘ Catalyze carrier



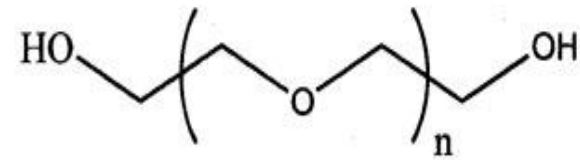
AIM

- Investigate if polymers may be used instead of kaolin as binders in Zeolite 13X granulation
- Evaluate effect on pH on the zeolite-polymer slurries/granules

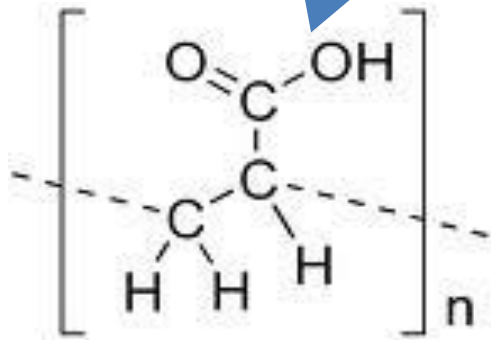


POLYMER SELECTION CRITERIA

- Solubility
- Non-toxicity
- Cost effectiveness
- Melting point

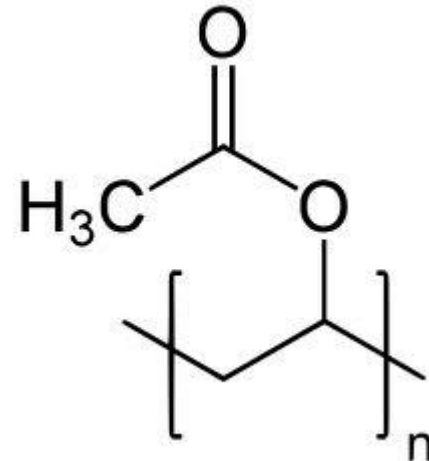


PEG

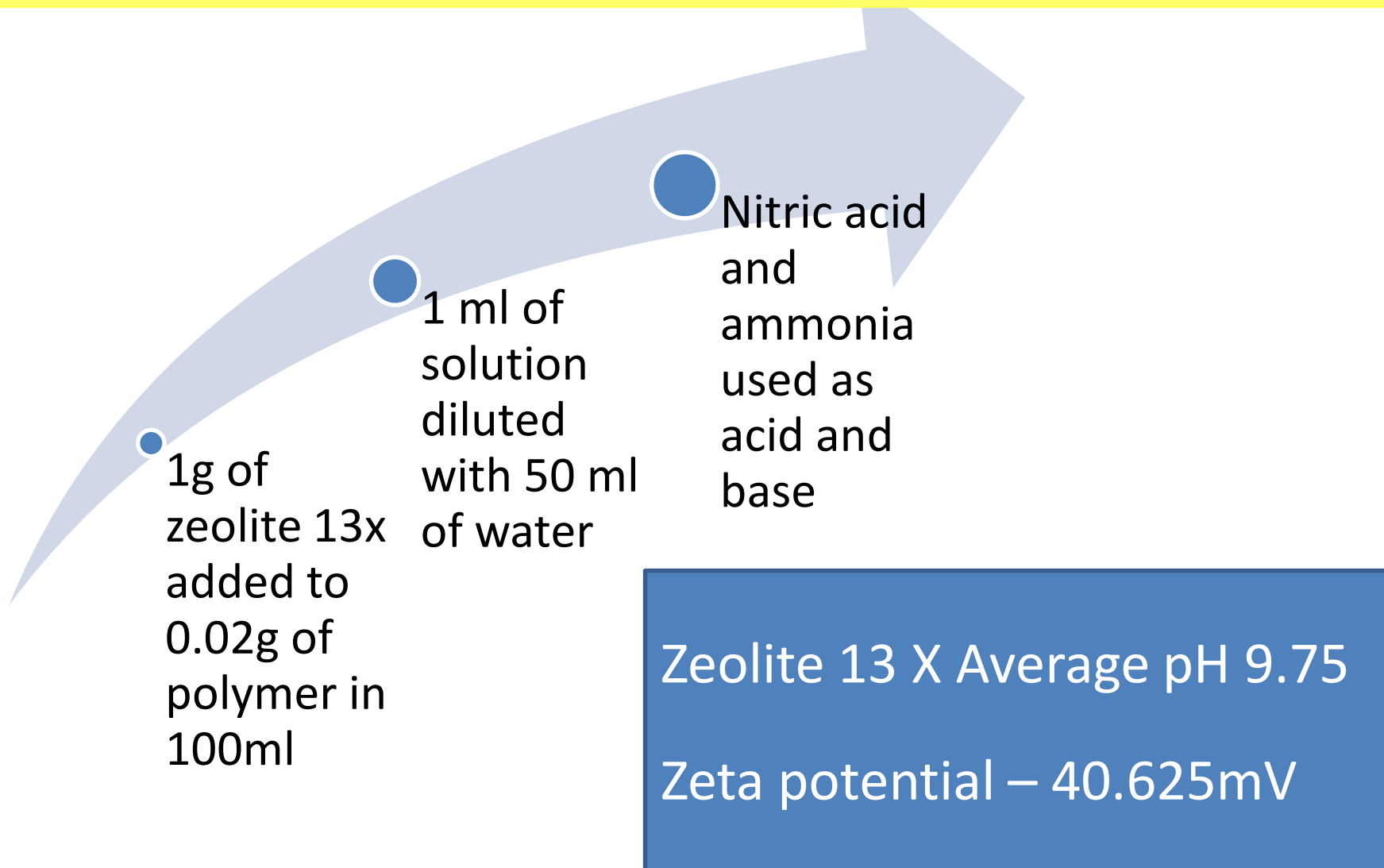


PAA

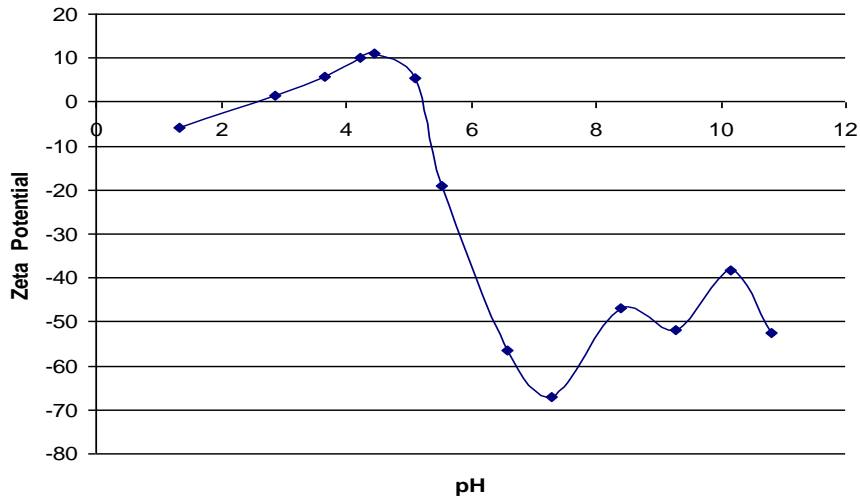
PVA



ZETA POTENTIAL - EXPERIMENTAL

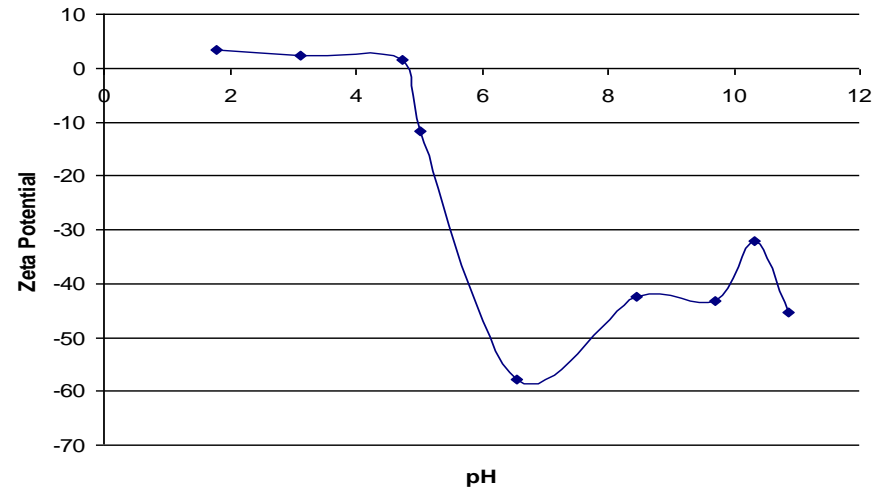


Graph 1 showing zeta potential versus pH (PAA)



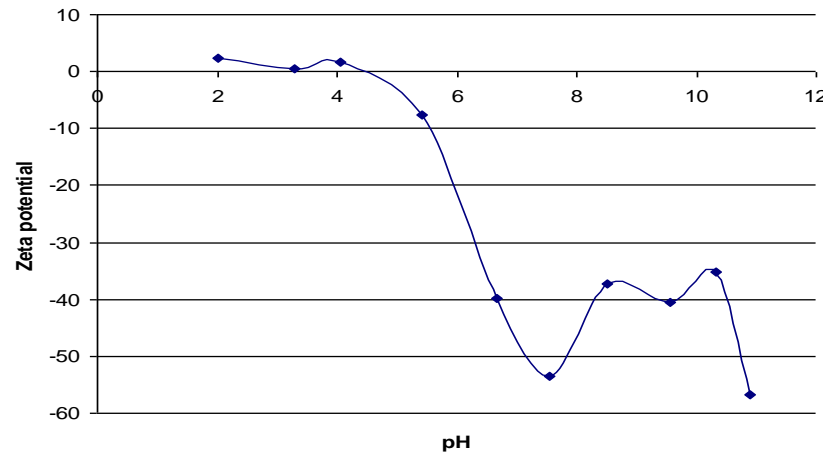
The isoelectric point is pH 5.54

Graph 2 showing Zeta Potential versus pH (PEG)



The isoelectric point is at pH 5.02

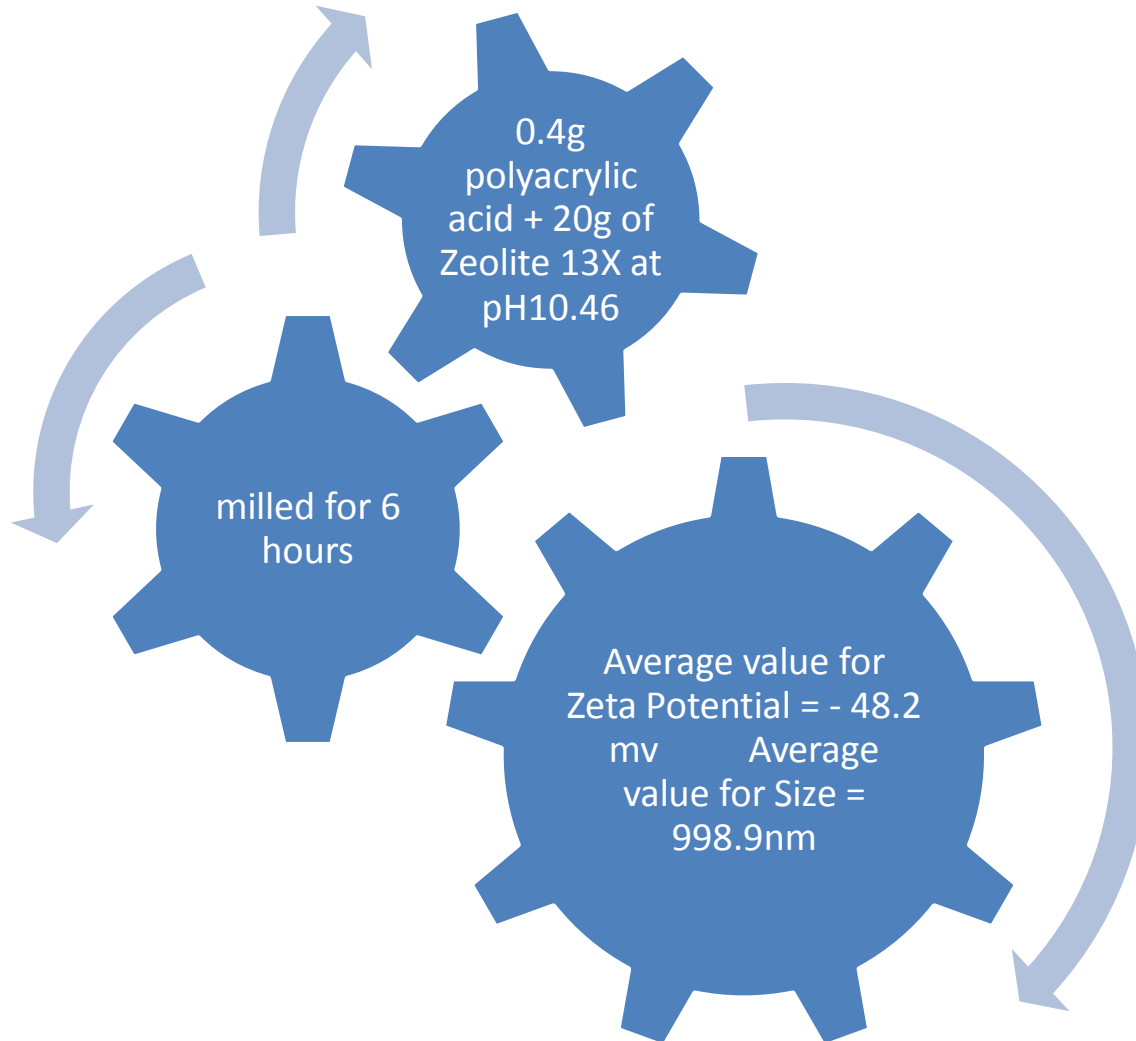
Graph 3 showing Zeta Potential versus pH (PVA)



The isoelectric point is 5.42



MEASUREMENT OF SIZE



HAMAKER CONSTANT

✘ Calculated value in air = $1.38 \times 10^{-19} \text{ J}$

✘ Calculated value in vacuum = $3.25 \times 10^{-20} \text{ J}$



SLURRIES- 20% SOLUTION

Polymer	Sample	mass of polymer (g)	microL of NH ₃ /HNO ₃	pH	mass of Zeolite (g)
PAA	1	0.3009		2.71	15.0042
PVA	2	0.3005	2400	10.05	15.0060
	3	0.3030	100	1.54	15.0050
	1	0.3002		6.25	15.0033
	2	0.3074	100	10.30	15.0083
	3	0.3014	23	3.89	15.0020
PEG	1	0.3005		5.81	15.0055
	2	0.3013	20	2.28	15.0042
	3	0.3001	100	9.86	15.0109



UV-Vis SPECTROSCOPY

Measuring absorption.....



UV-VIS SPECTROSCOPY

INDICATORS

PAA

- HYAMINE

PVA

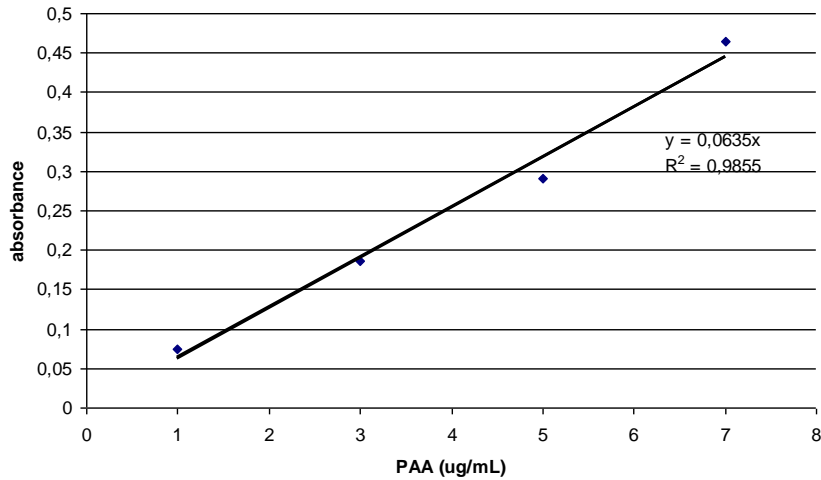
- BORIC ACID

PEG

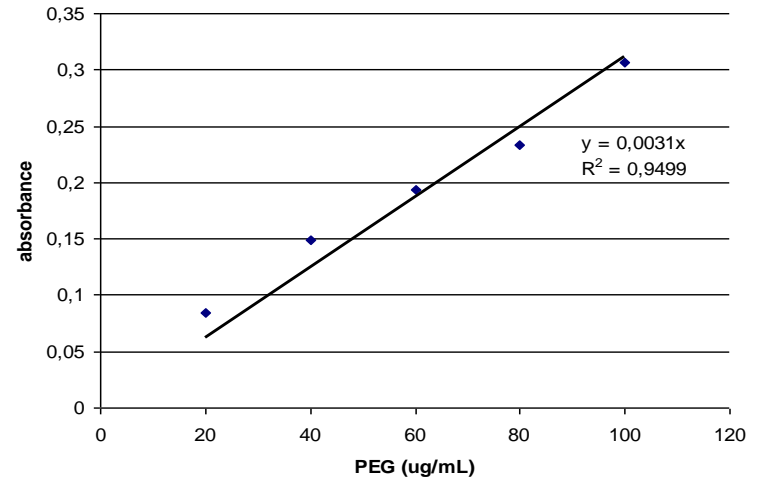
- BARIUM CHLORIDE + IODINE



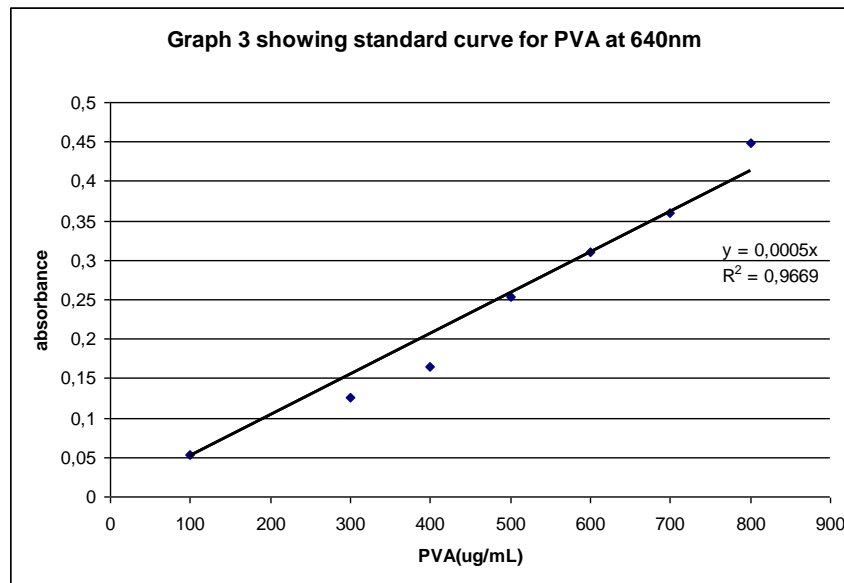
Graph 1 showing standard curve for PAA at 420nm



Graph 2 showing standard curve of PEG at 661nm



Graph 3 showing standard curve for PVA at 640nm

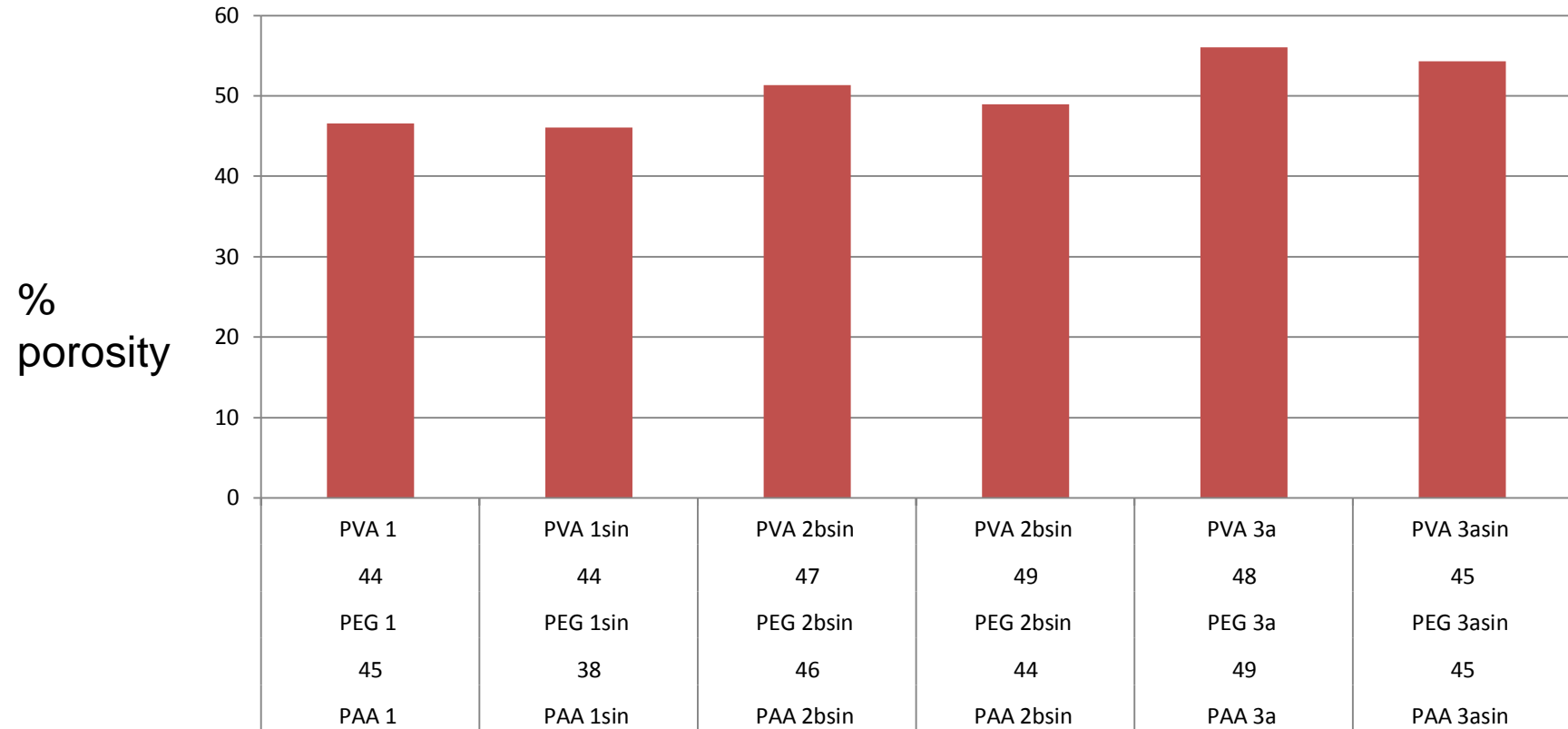


MERCURY POROSIMETRY

Intrusion technique.....



MERCURY POROSIMETRY



CONCLUSION

- Zeta potential solutions more stable in basic conditions.
- Hamaker constant polymer may efficiently bind to the zeolite due to Van der Waals interactions.
- The UV-Vis measurements -PAA showed the least absorption while PVA had the most absorption.
- There is a %porosity ranged from 38-56% for the polymers PVA, PEG and PAA



FUTURE WORKS

- Mechanical properties to be tested: tensile modulus, compressive strength, fracture analysis
- Binary System of Polymers
- Characterisation techniques: X-ray diffraction, Scanning Electron Microscope, CO₂ adsorption
- Modeling with Computer Simulations-DVLO theory to evaluate Van Der Waals forces



Thank You

