I THANK THE ORGANIZERS TO GIVE ME THE OPPORTUNITY

TO ATTEND THIS VERY INTERESTING SYMPOSIUM

AND I APPRECIATE THEIR EFFORTS

TO BRING TOGETHER SPECIALISTS IN THIS EXCITING FIELD!

NOVEL BIPOLAR RESINS

SYNTHESIS AND THEIR RETENTION PROPERTIES OF INORGANIC SALTS

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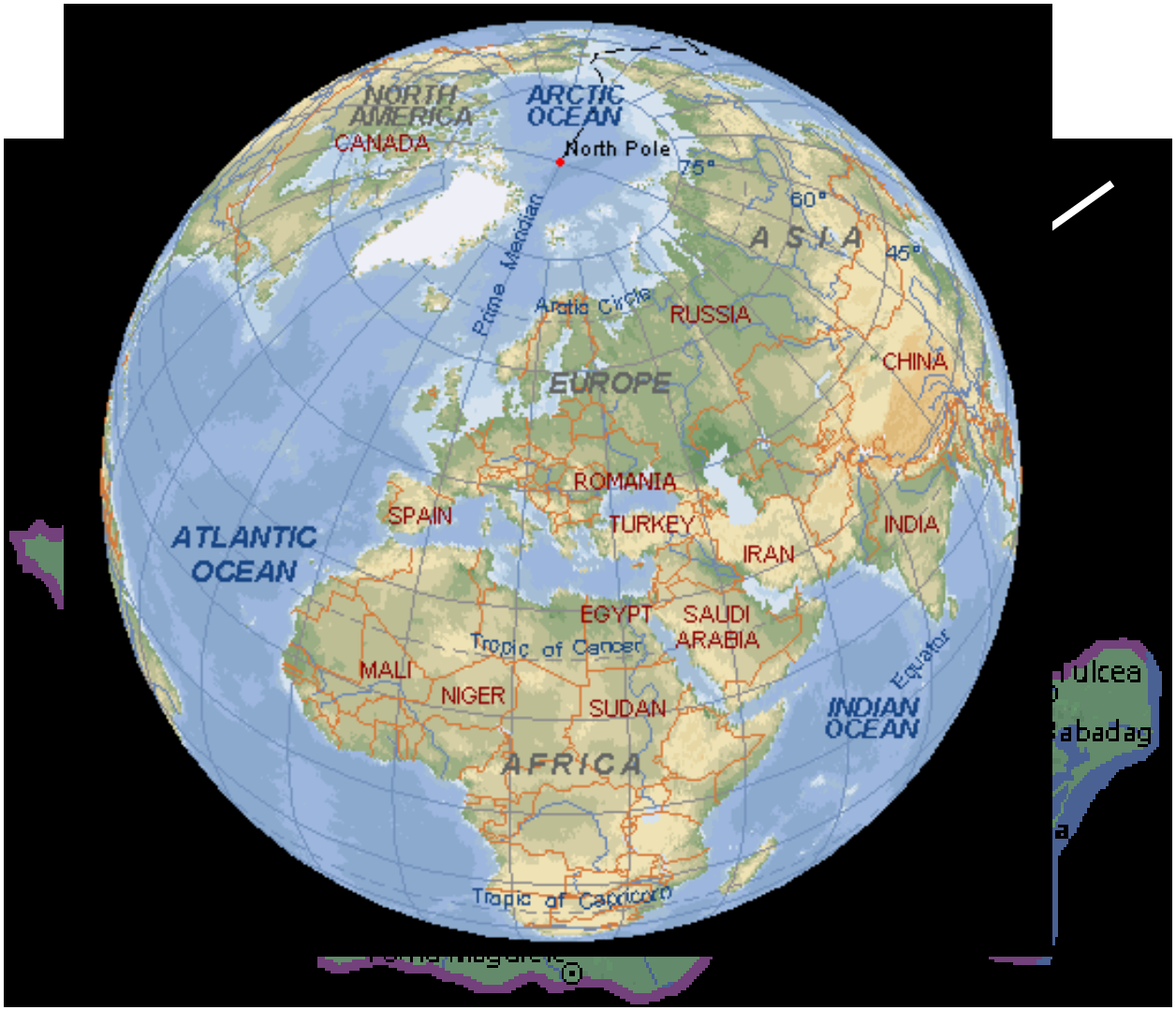
"PETRU PONI" INSTITUTE OF MACROMOLECULAR CHEMISTRY, IASI

ROMANIA


NORTH AMERICA
CANADA
ARCTIC OCEAN
North Pole
75°
60°
45°
ASIA
Prime Meridian
Arctic Circle
RUSSIA
CHINA
EUROPE
ROMANIA
SPAIN
TURKEY
INDIA
IRAN
ATLANTIC OCEAN
EGYPT
SAUDI ARABIA
Tropic of Cancer
MALI
NIGER
SUDAN
Equator
INDIAN OCEAN
AFRICA
Tropic of Capricorn

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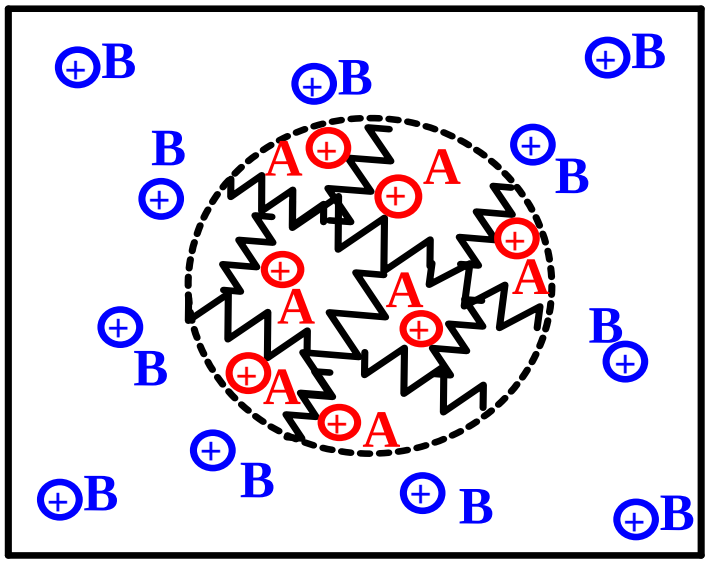
II. RETENTION STUDY OF THE HEAVY METALS ON THE PYRIDINE BIPOLAR RESINS

ION EXCHANGER

WHAT IS IT?



Ion exchangers are solid polyelectrolytes which can exchange their mobile ions for ions of the same charge from the sorrounding medium.

The ion exchangers are tools for the established procedures and technologies of the ion exchange.

BENEFITS OF THE ION EXCHANGE PROCESS:

- highly efficient process, > 99.9% removal of desired ions
- very high water recovery, > 97%
- predictable performance
- ability to remove selective impurities
- re-use after regeneration up to several cycles

APPLICATIONS OF ION EXCHANGERS:

WATER TREATMENT

HYDROMETALLURGY

FOOD INDUSTRY

CHEMICAL PROCESS INDUSTRY

BIOCHEMISTRY AND BIOTECHNOLOGY, PHARMACEUTICALS

MEDICINE, POLLUTION CONTROL, ANALYTICAL CHEMISTRY…….

……

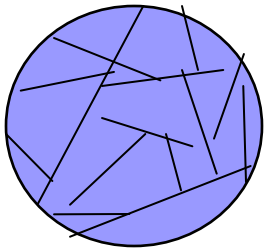
HOW DOES IT WORK?

ORGANIC **INORGANIC**

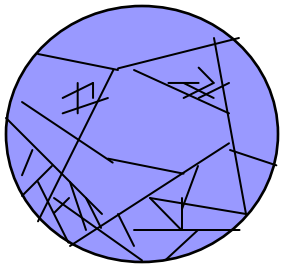
NATURAL

SYNTHETIC

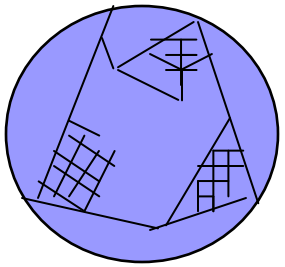
Polymerization **Polycondensation**



GEL TYPE



ISOPOROUS TYPE



MACROPOROUS TYPE

ION EXCHANGE MATERIALS

Beads
Films
Fibers
Fabrics
Tubes
Foams
Plates

BEADS OR GRANULES

THERE ARE QUITE A NUMBER OF
DIFFERENT TYPES OF ION EXCHANGERS BUT
THOSE BASED ON BEADS OR GRANULES ORGANIC POLYMERS
BECOME THE MOST IMPORTANT

CATION EXCHANGER

- ***Weak* Acid:**
  - **- COOH → carboxylic acid**
  - **- C_6H_5 -OH → phenolic hydroxyl**

- **Strong Acid:**
  - **-C_6H_5 –SO_3H → aryl sulfonic**

ANION EXCHANGER:

- ***Weak* Base:**
  - **-NH_2 → primary amine**
  - **-NHR → secondary amine**
  - **-NR_2 → tertiary amine**

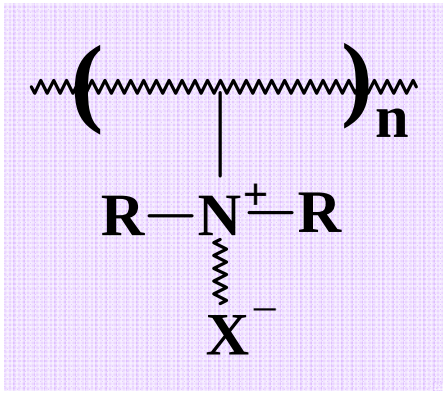
- **Strong Base:**
  - **>N^+< → quaternary ammonium**
  - **>P^+< → phosphonium**
  - **- S^+< → sulfonium**

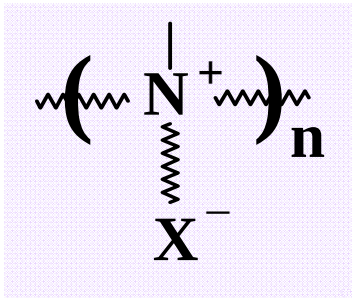
BIPOLAR EXCHANGERS: **mixture of acid and base groups**

- **Amphoteric**
- **Zwitterionic**

ZWITTERIONIC EXCHANGERS

ION EXCHANGERS WITH BETAINE STRUCTURES





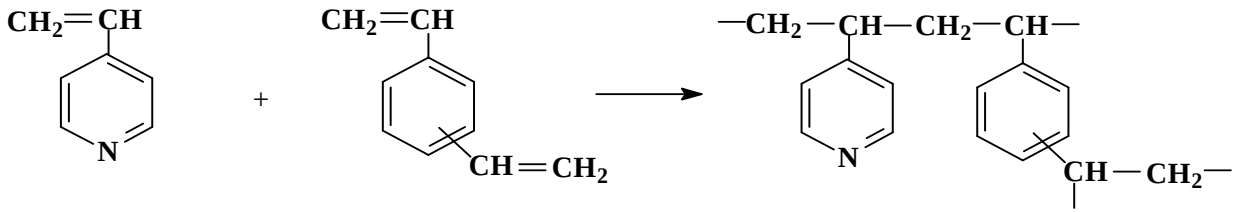
Where X^- = carboxylate — **CROSSLINKED POLYCARBOXYBETAINES**

= sulfonate — **CROSSLINKED POLYSULFOBETAINES**

= phosphate/ phosphonate/ phosphinate — **CROSSLINKED POLYPHOSPHOBETAINES**

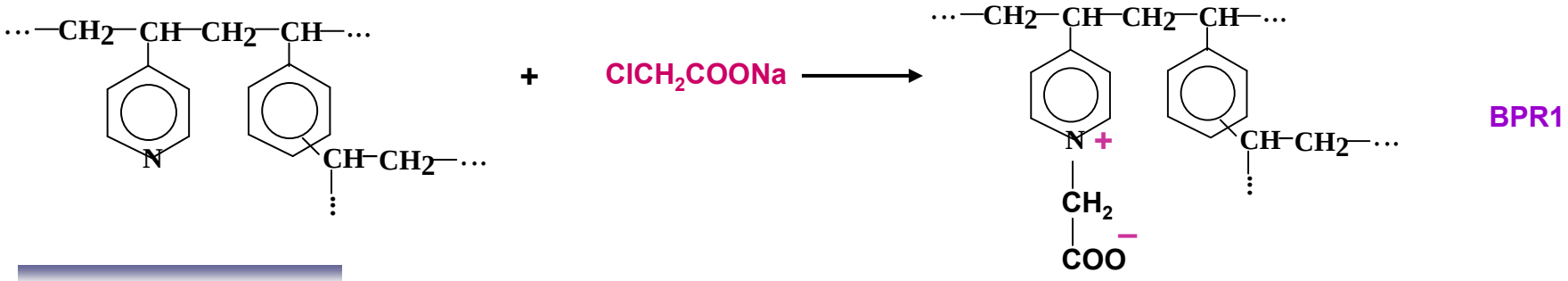
SYNTHESIS OF CROSSLINKED POLYCARBOXYBETAINES

1. Synthesis of 4-vinylpyridine : divinylbenzene copolymers

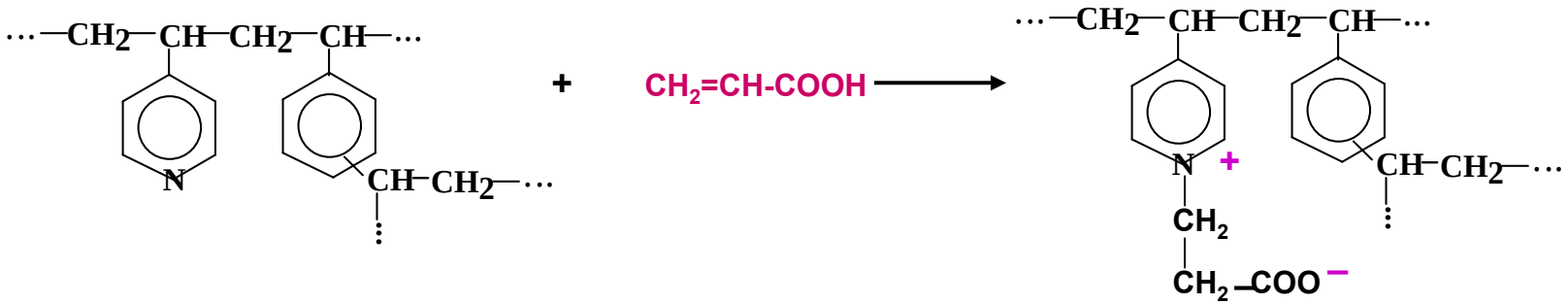


2. Synthesis of polycarboxybetaines

Nucleophilic substitution



Nucleophilic addition

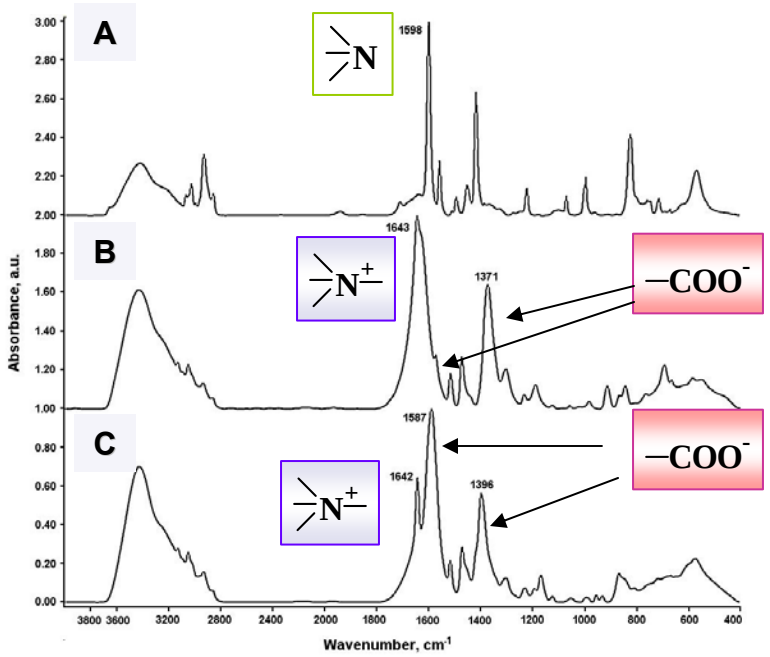


FT-IR characterization of the bipolar pyridine resins

4-VP : DVB

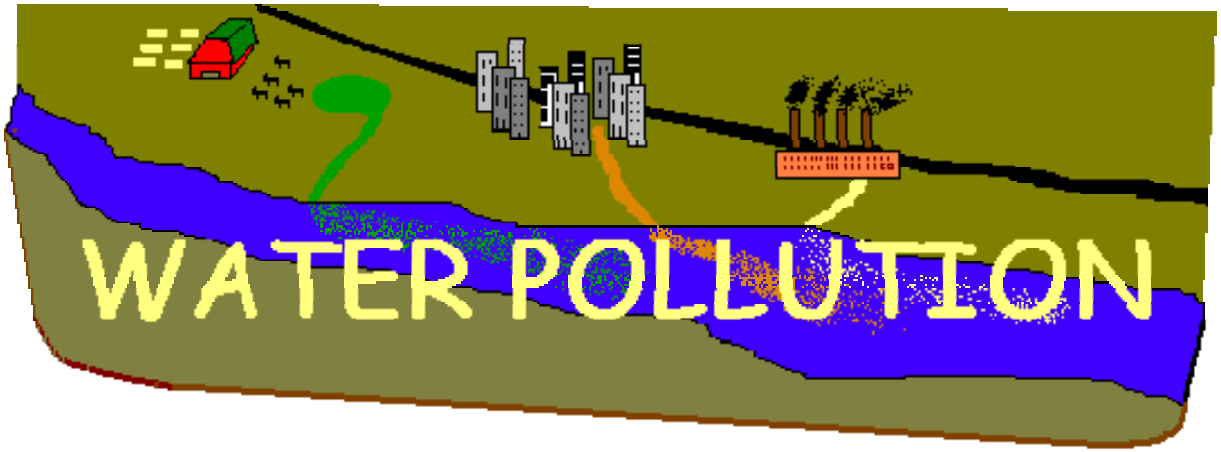
BPR1
DB = 90%

BPR2
DB = 94%



Chemical stability of the bipolar pyridine resins

- HCl
- Na_2CO_3



The most polluting sources are the city sewage and industrial waste discharged into the rivers.

TODAY

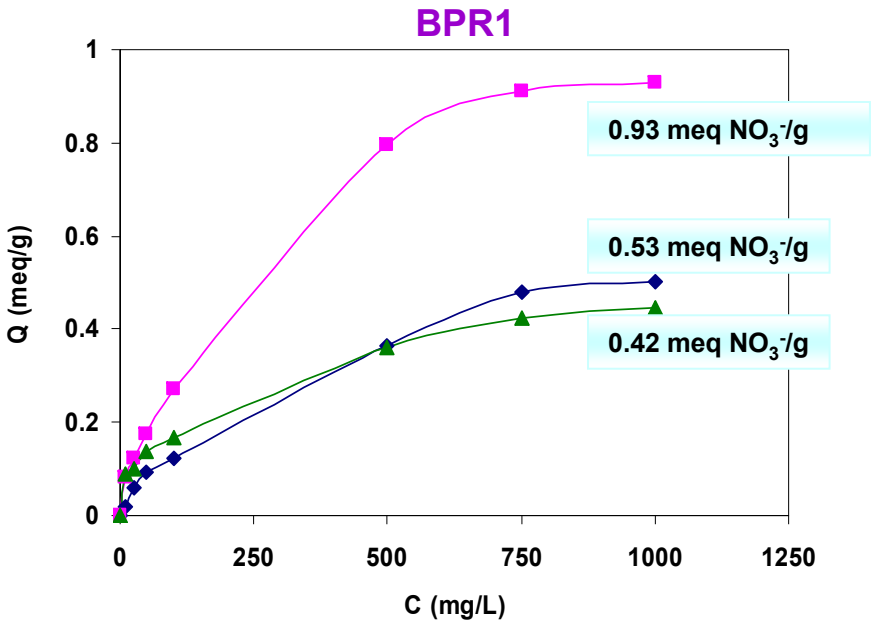
Roadways and automobiles are considered to be one of the largest sources of heavy metals

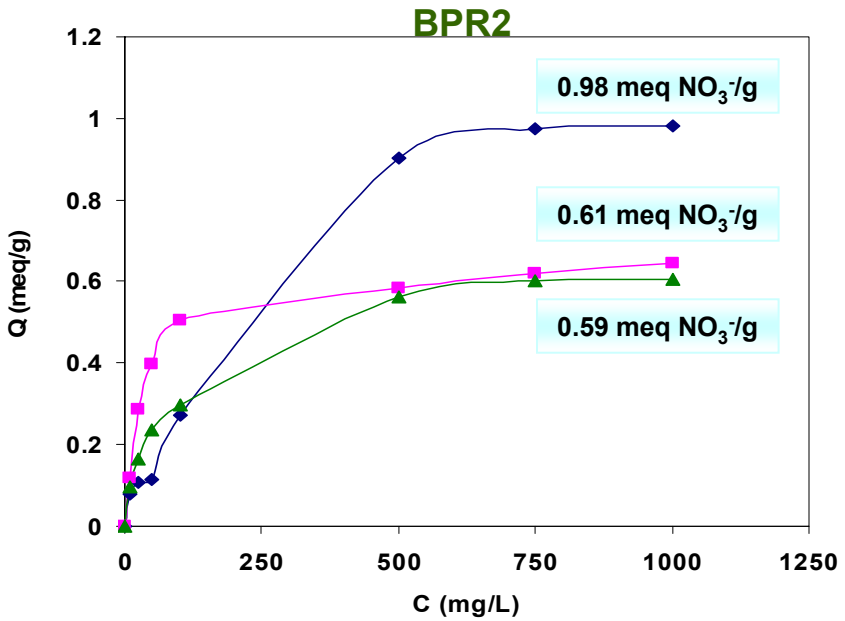
COMMON METALS IN ROAD RUNOFF
Lead: leaded gasoline, tire wear, lubricating oil and grease, bearing wear
Zinc: tire wear, motor oil, grease, brake emissions, corrosion of galvanized parts
Iron: auto body rust, engine parts
Copper: bearing wear, engine parts, brake emissions
Cadmium: tire wear, fuel burning, batteries
Chromium: air conditioning coolants, engine parts, brake emissions
Nickel: diesel fuel and gasoline, lubricating oil, brake emissions
Aluminum: auto body corrosion

METAL RETENTION STUDY ON THE CROSSLINKED POLYCARBOXYBETAINES

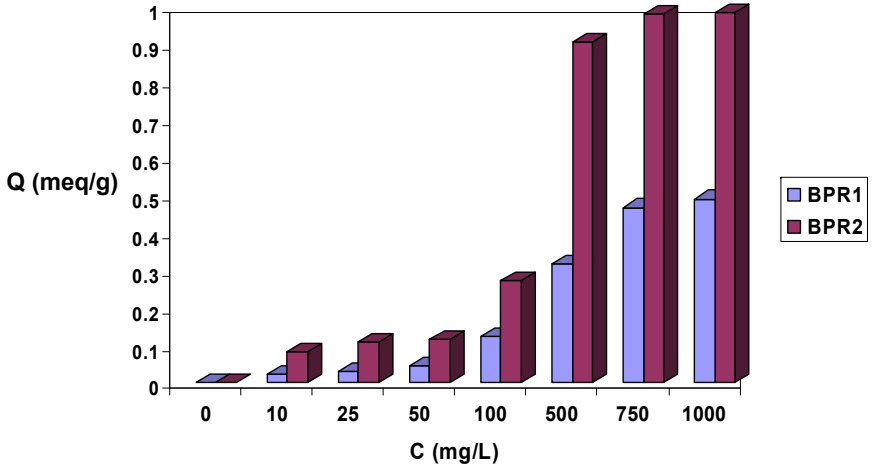
1. Thermodynamic study

Cu Cd Co $(NO_3^-)_2$

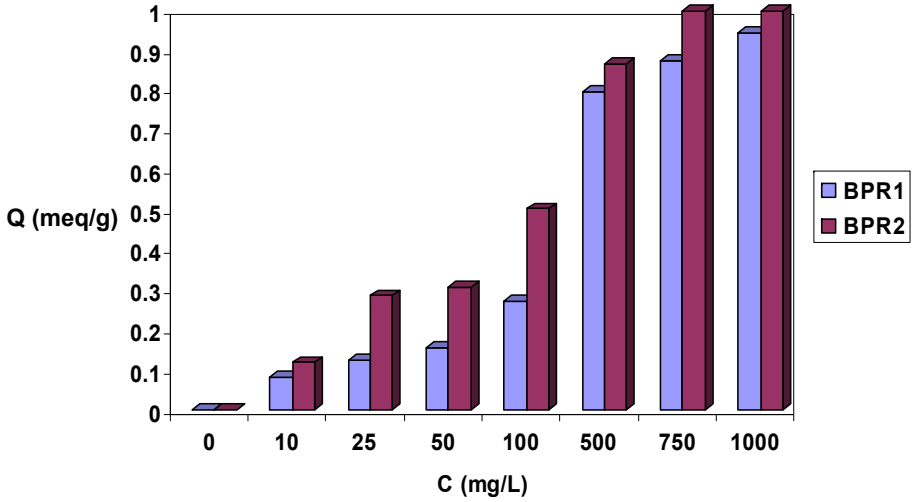




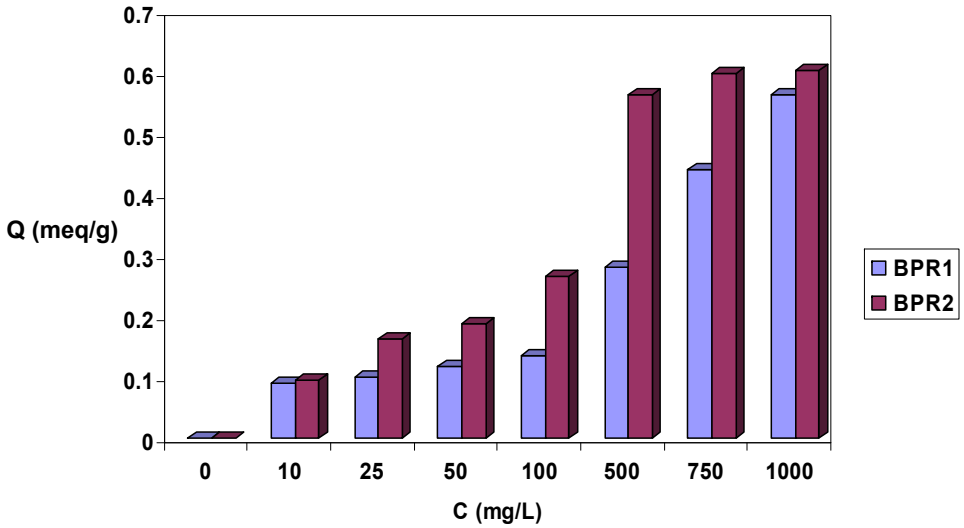
Cd(II)



Cu(II)

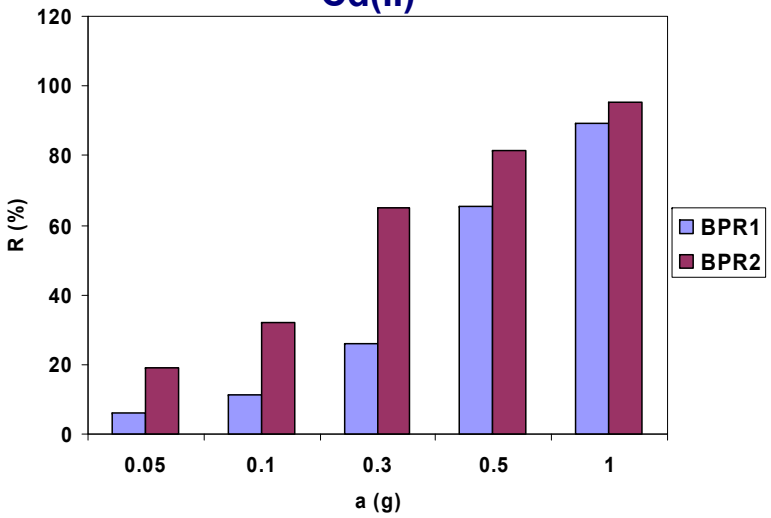


Co(II)

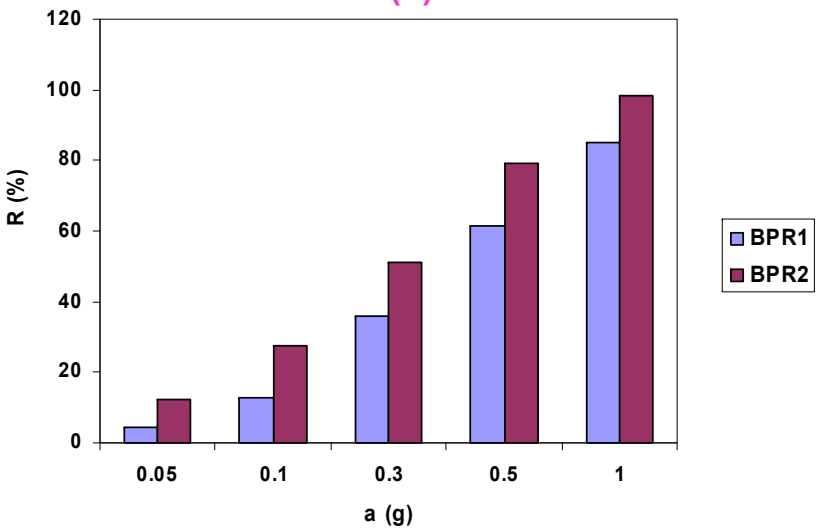


Recovery factor of the studied heavy metals

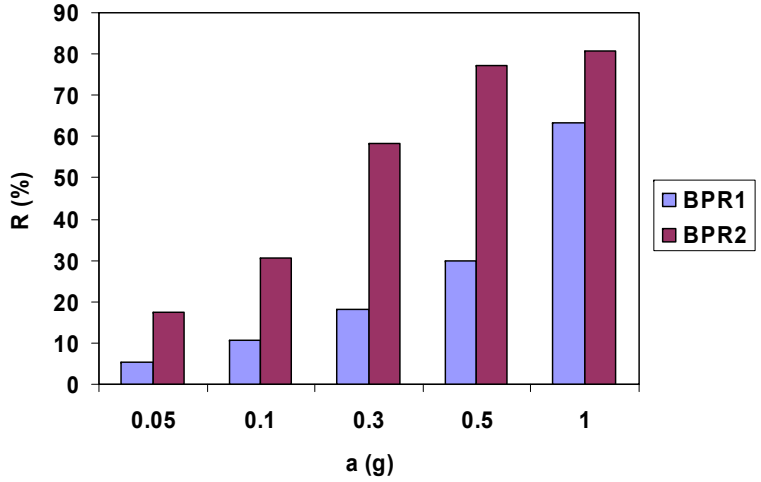
Cd(II)



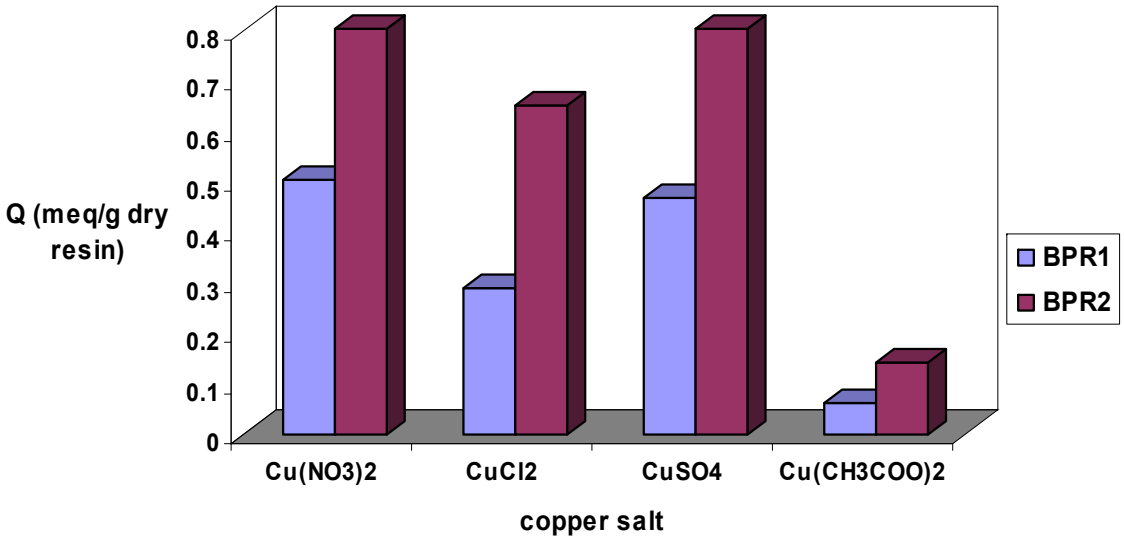
Cu(II)



Co(II)

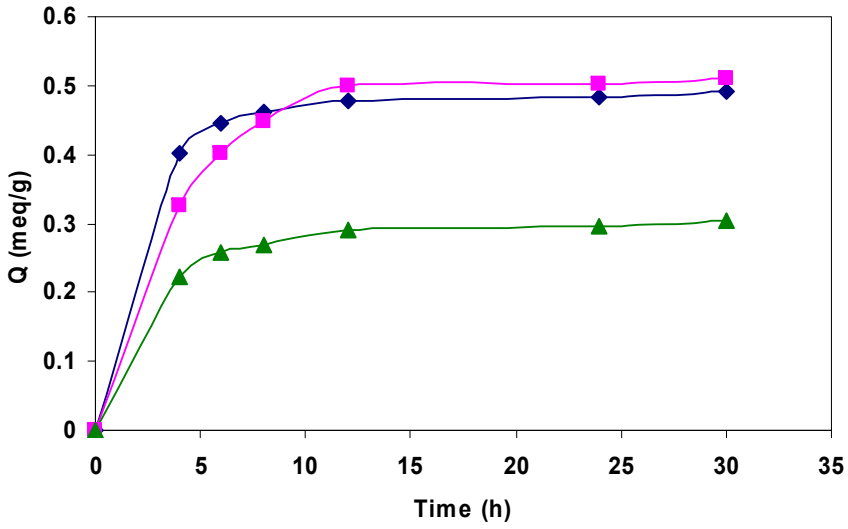


Retention of Cu(II) from various salts

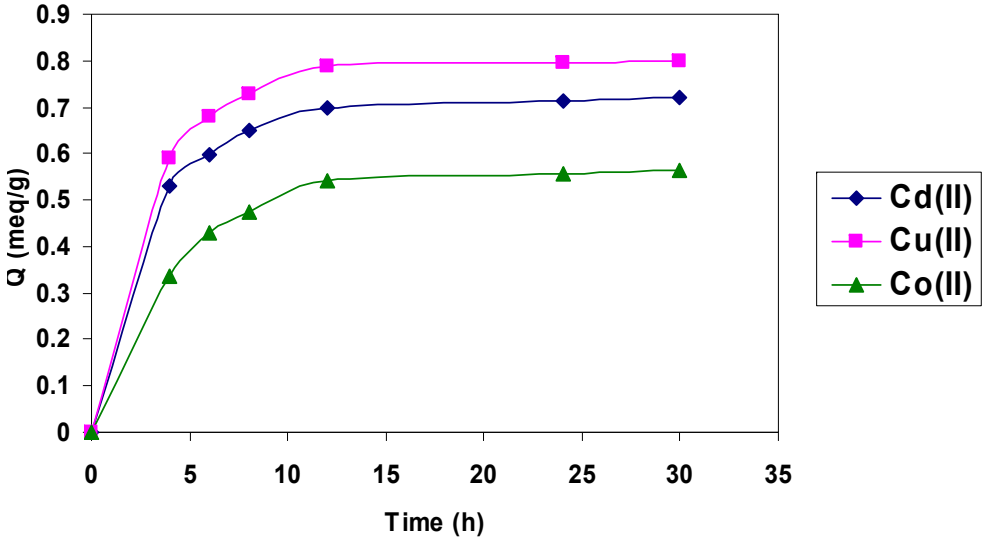


2. Kinetic study

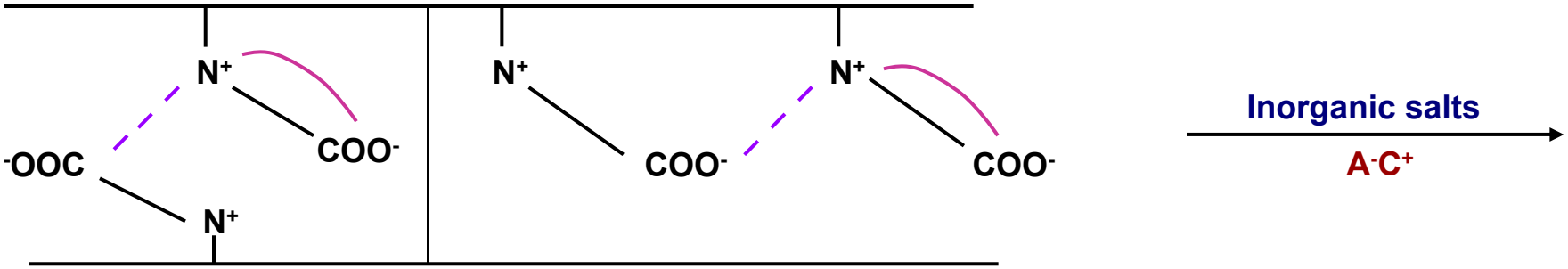
BPR1



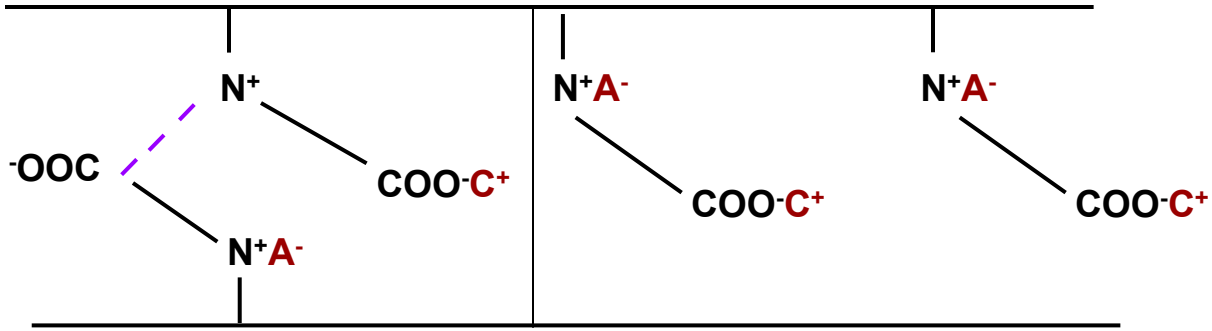
BPR2



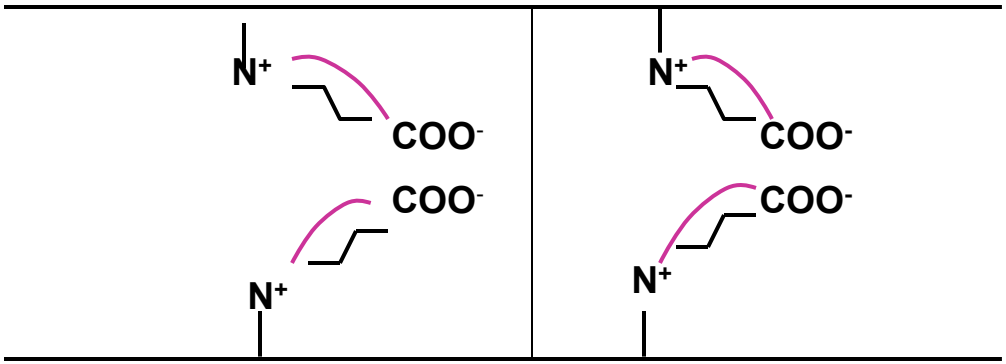
BPR1



Inter- chain and intra - groups bindings



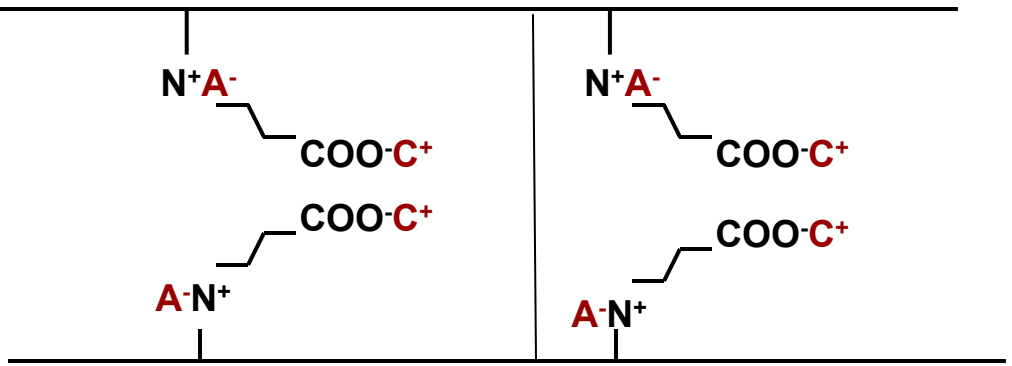
BPR2



Inorganic salts

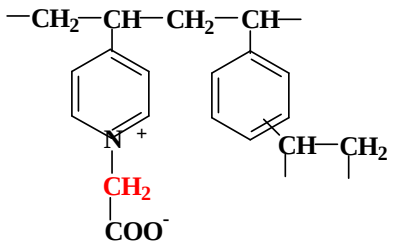
A^-C^+

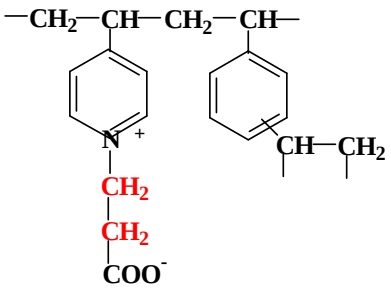
Intra- group bindings



CONCLUSIONS

CROSSLINKED POLYCARBOXYBETAINES BASED ON 4-VINYLPYRIDINE : DIVINYLBENZENE





BIPOLAR ION EXCHANGERS CONCOMITENTLY BIND THE CATIONS AND ANIONS (A^-C^+) FROM INORGANIC SALTS

THANK YOU FOR YOUR ATTENTION!