Application of Ion Exchange in Wastewater Treatment

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RESINTECH® INC.
INNOVATIONS IN ION EXCHANGE

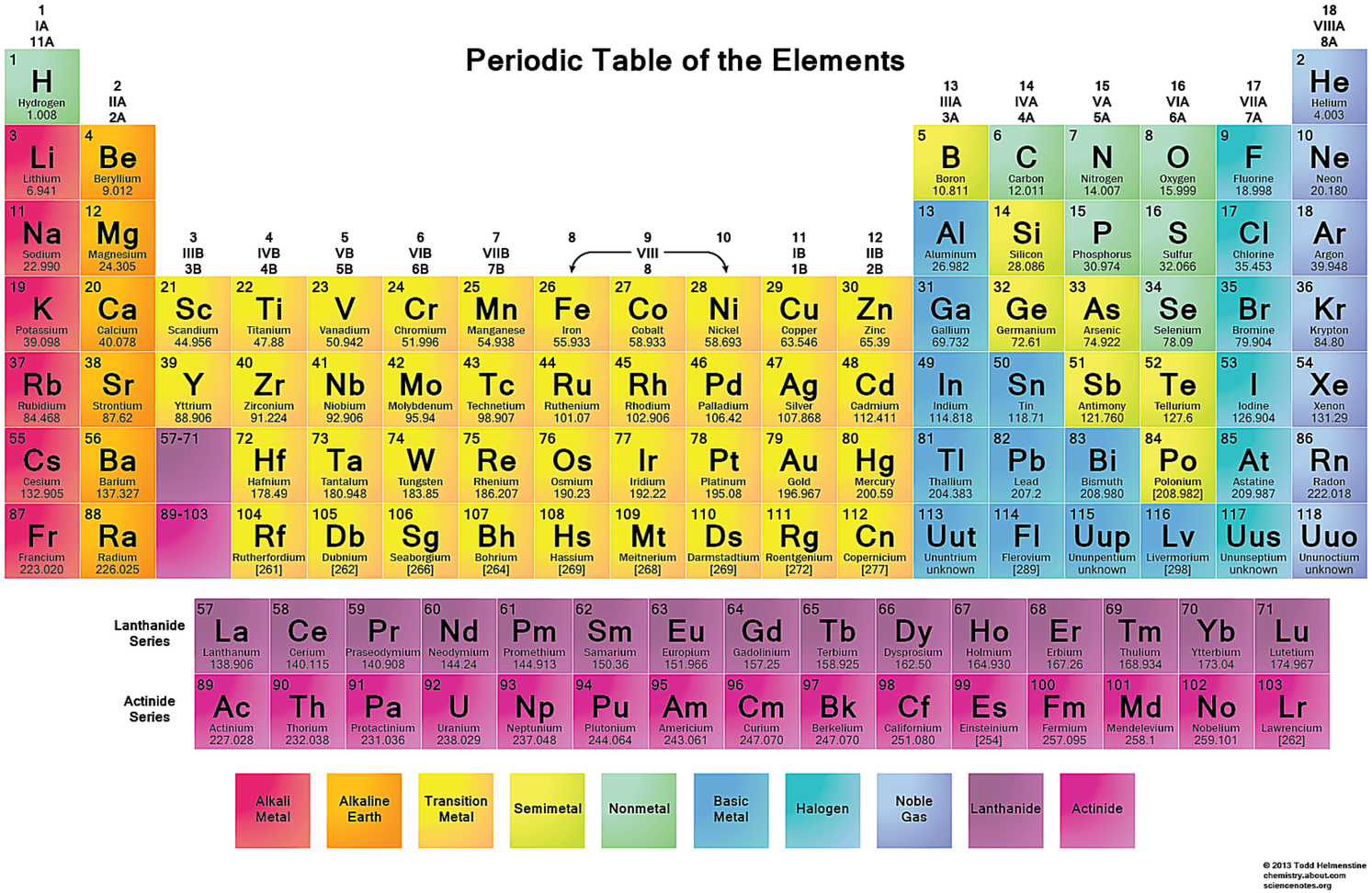
Topics of Discussion

- Understanding “Metals” in Water
- How Ion Exchange Works- Short Version
- Resin Type Review
- What We Need to Know
- Basic Application Review
- Q & A

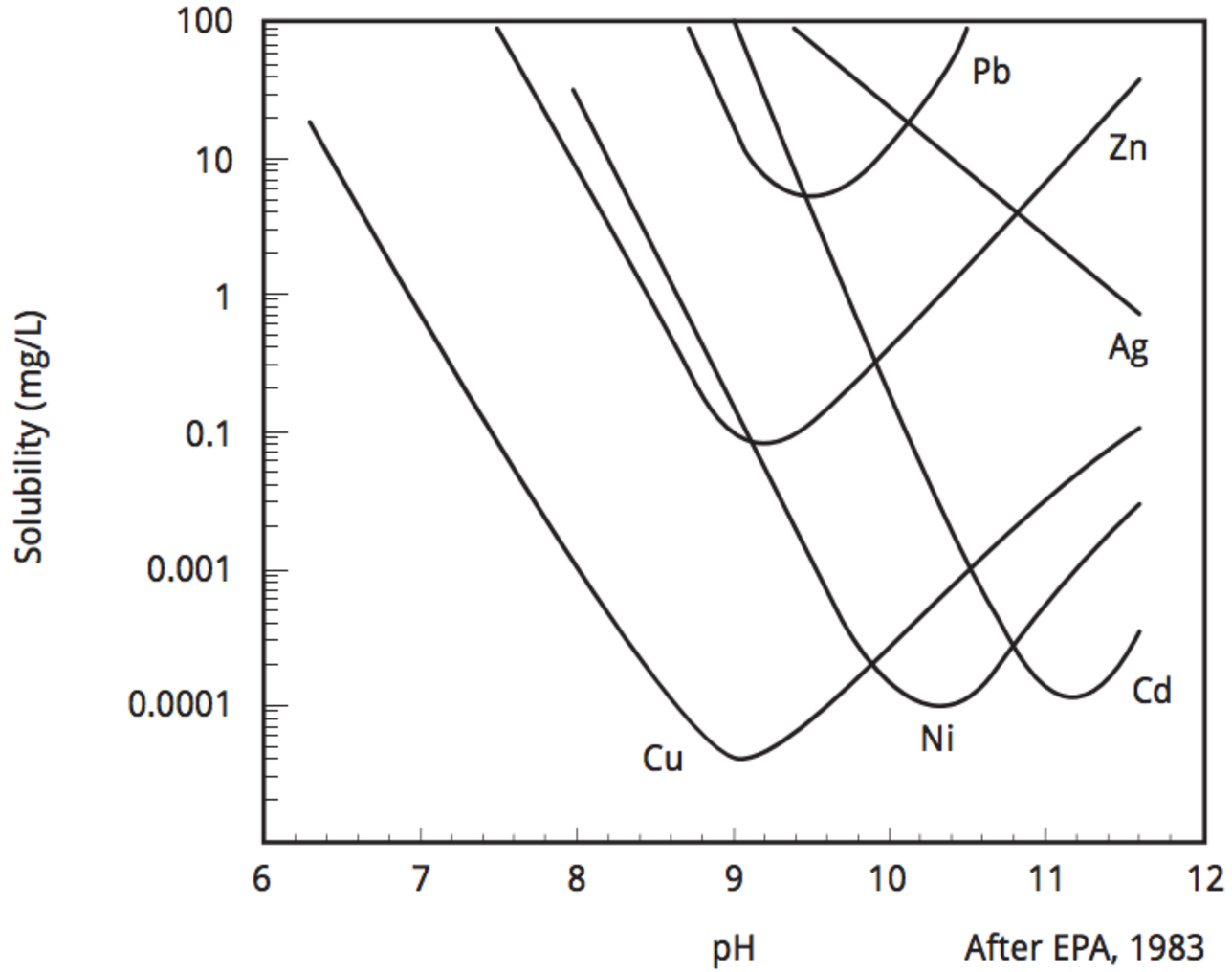
Metals in Waste Water

- Is what you want to remove cationic or anionic?
- Are the metals soluble or insoluble?
  - pH dependent (hydroxide solubility)
  - Other chemistry can complex
  - Filtered vs Unfiltered Results
- Analysis data doesn’t always tell the whole story.

Yes, the Periodic Table

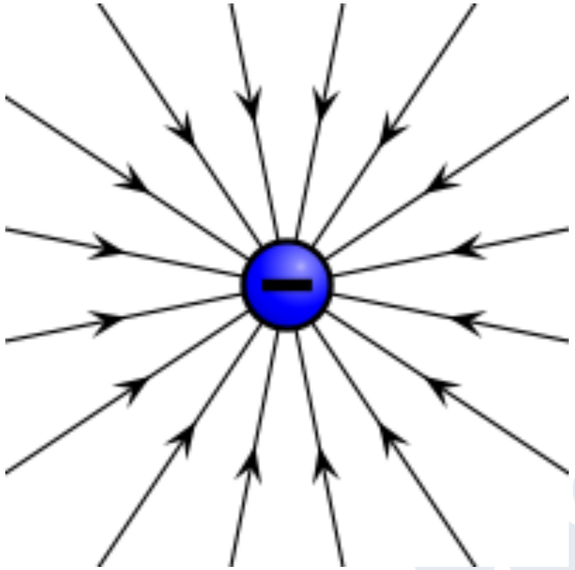


Metal Hydroxide Solubility



Common Anionic Contaminants

- Arsenic
- Antimony
- Chromate (Hex)
- Uranium
- Cyanide
- Perchlorate
- Nitrate



Ion Exchange Today

- Tiny plastic beads that have been chemically activated
- They are manufactured products that are made from petrochemical based monomers

Ion Exchange Today

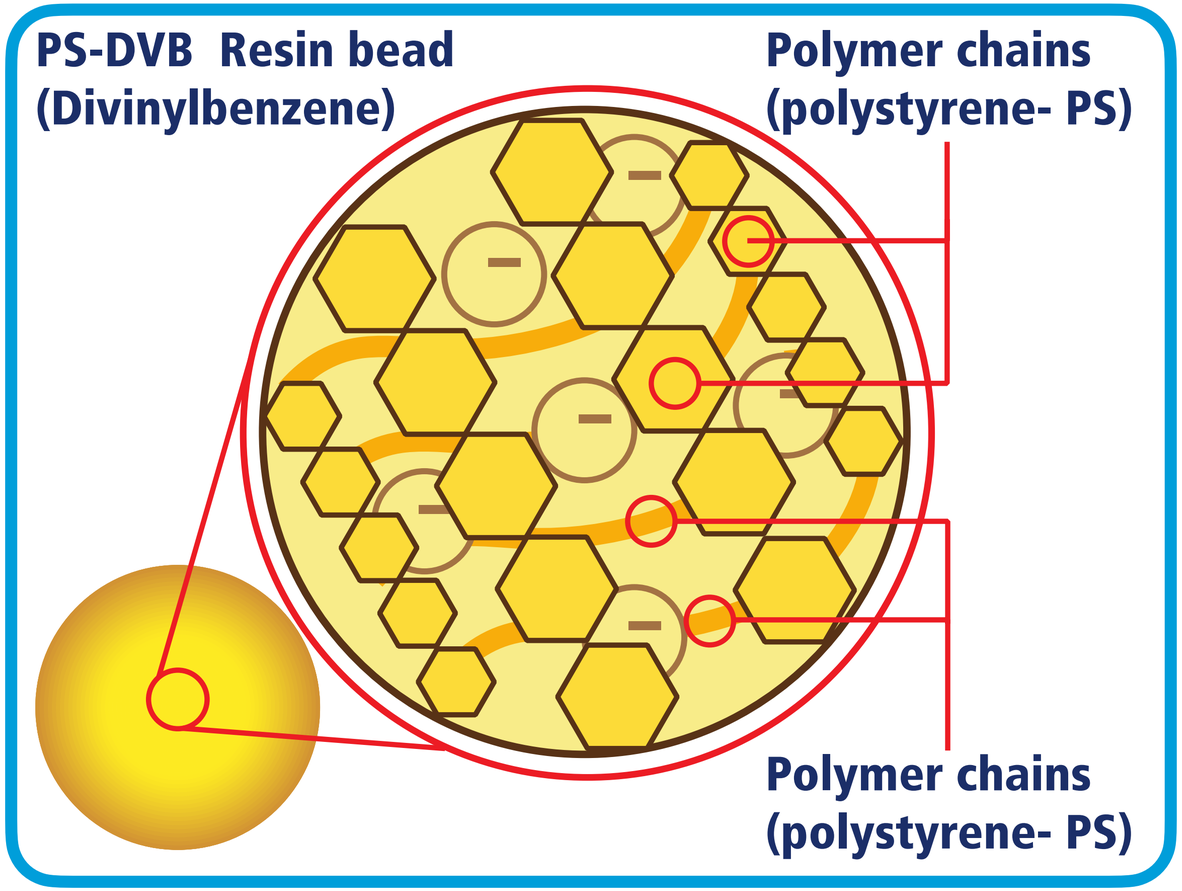
Material Properties

- Size between 16 to 50 U.S. Mesh
- Resistance to fracture
- Insoluble
- Permanently attached sites
- High capacity for ions
- Temperature effects negligible

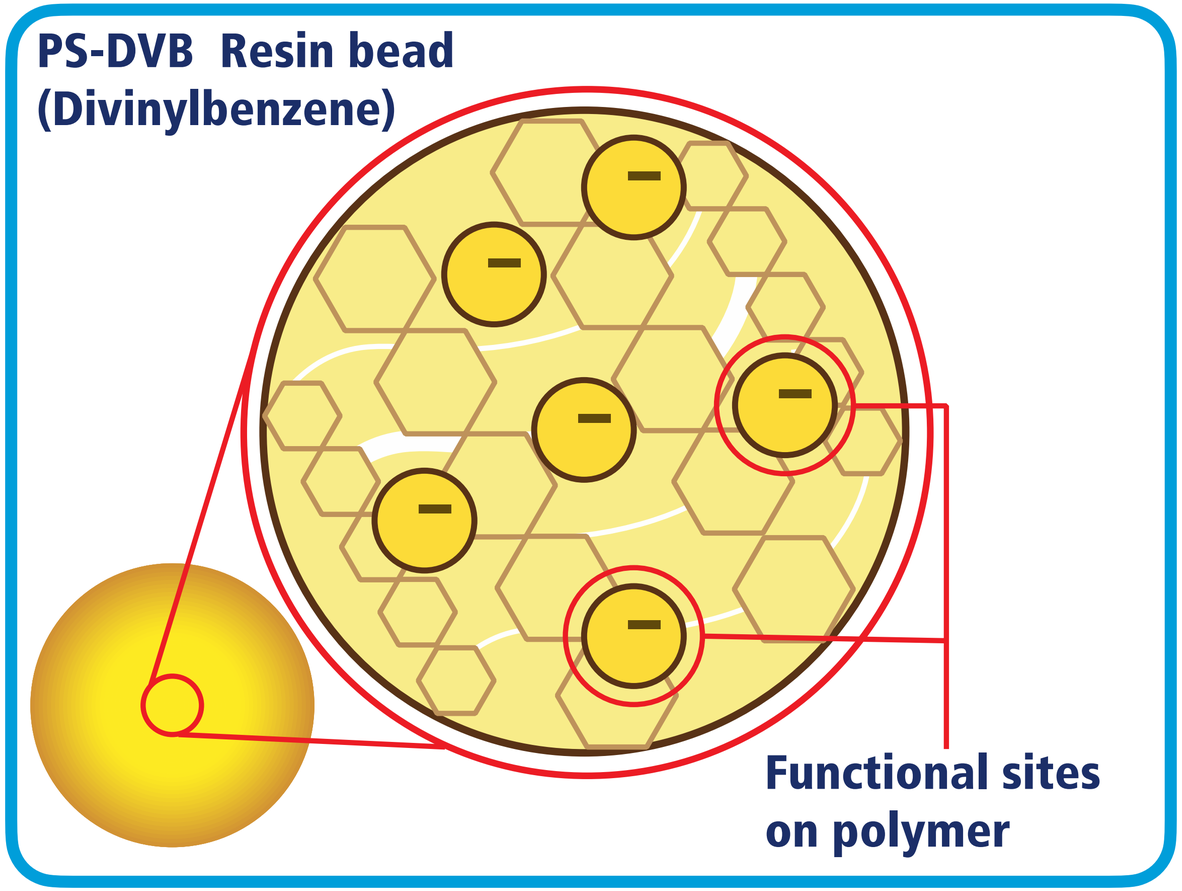
What is Ion Exchange?

- Exchange of undesirable ions for desirable ones
- Selectivity drives the reaction
- The process is reversible via regeneration

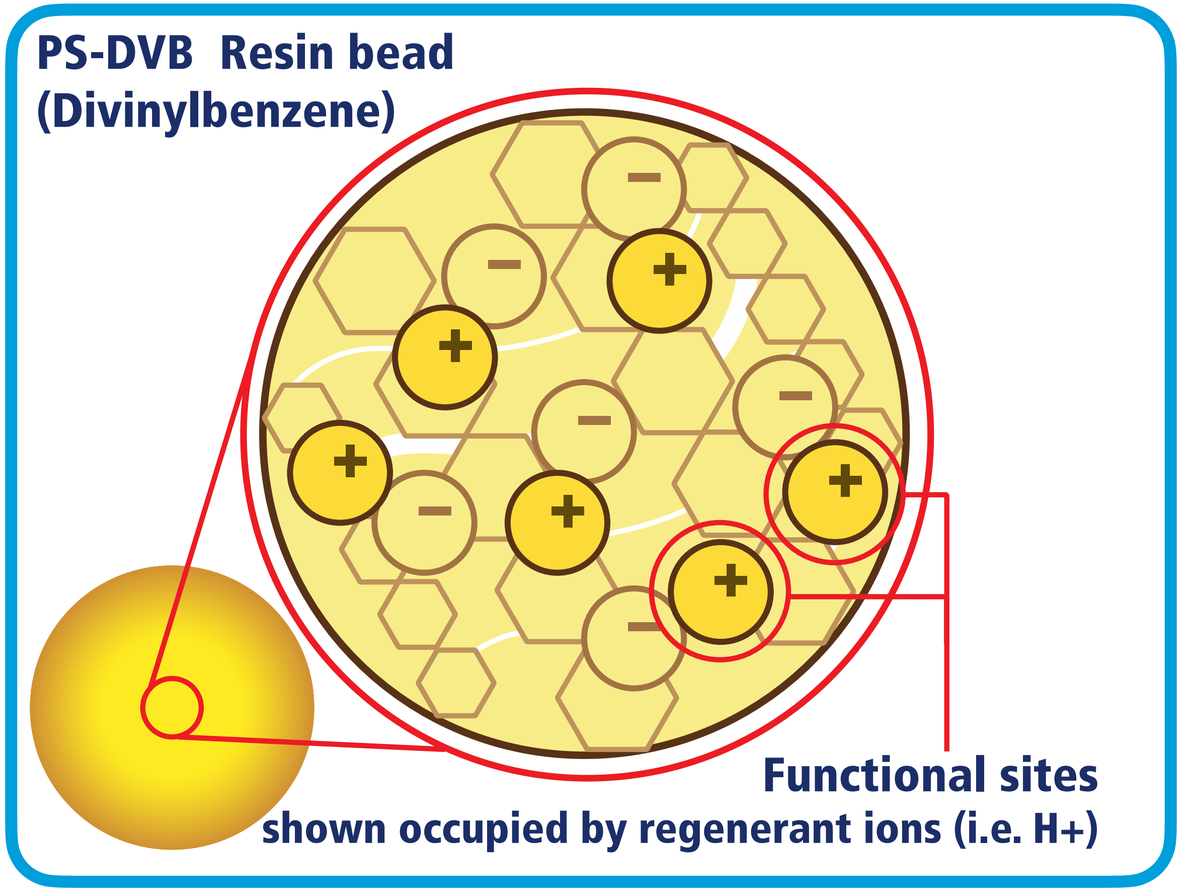
Inside the Resin Bead



Inside the Resin Bead

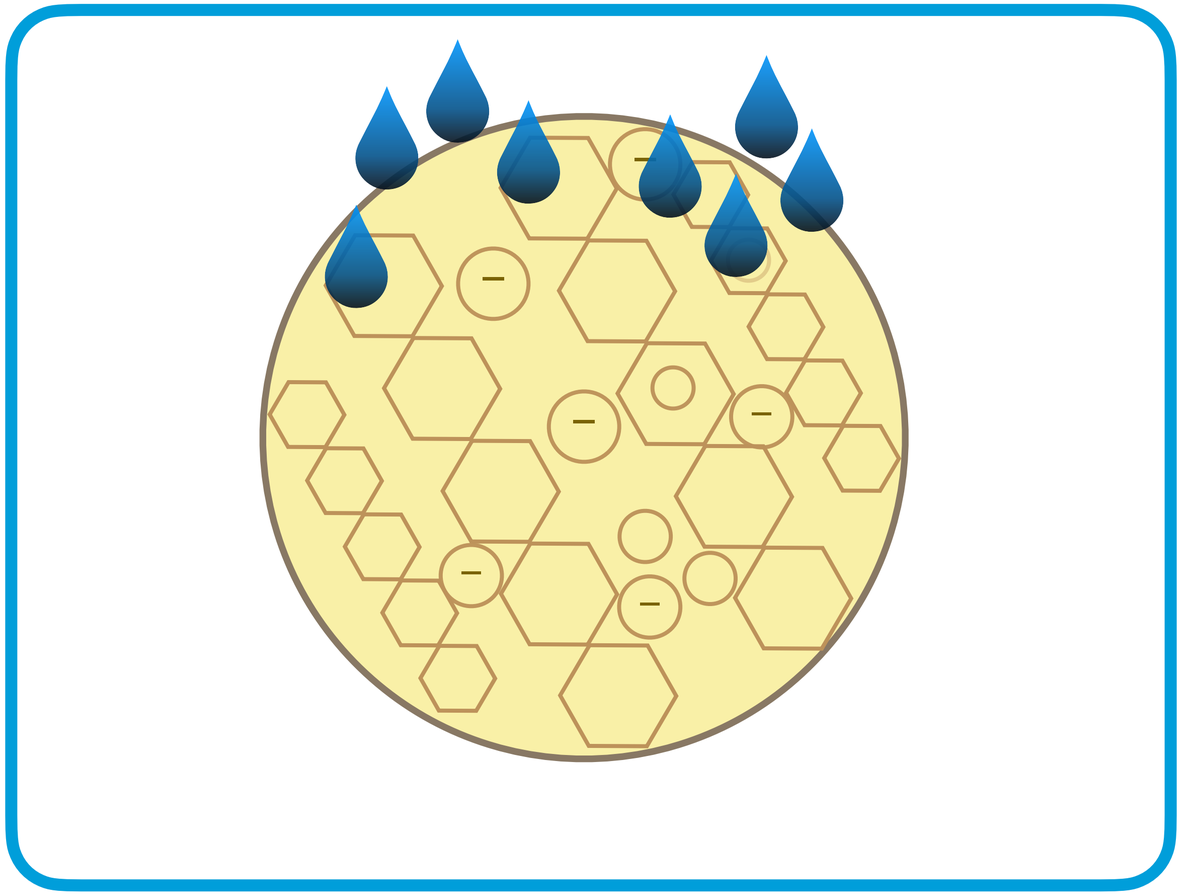


Inside the Resin Bead



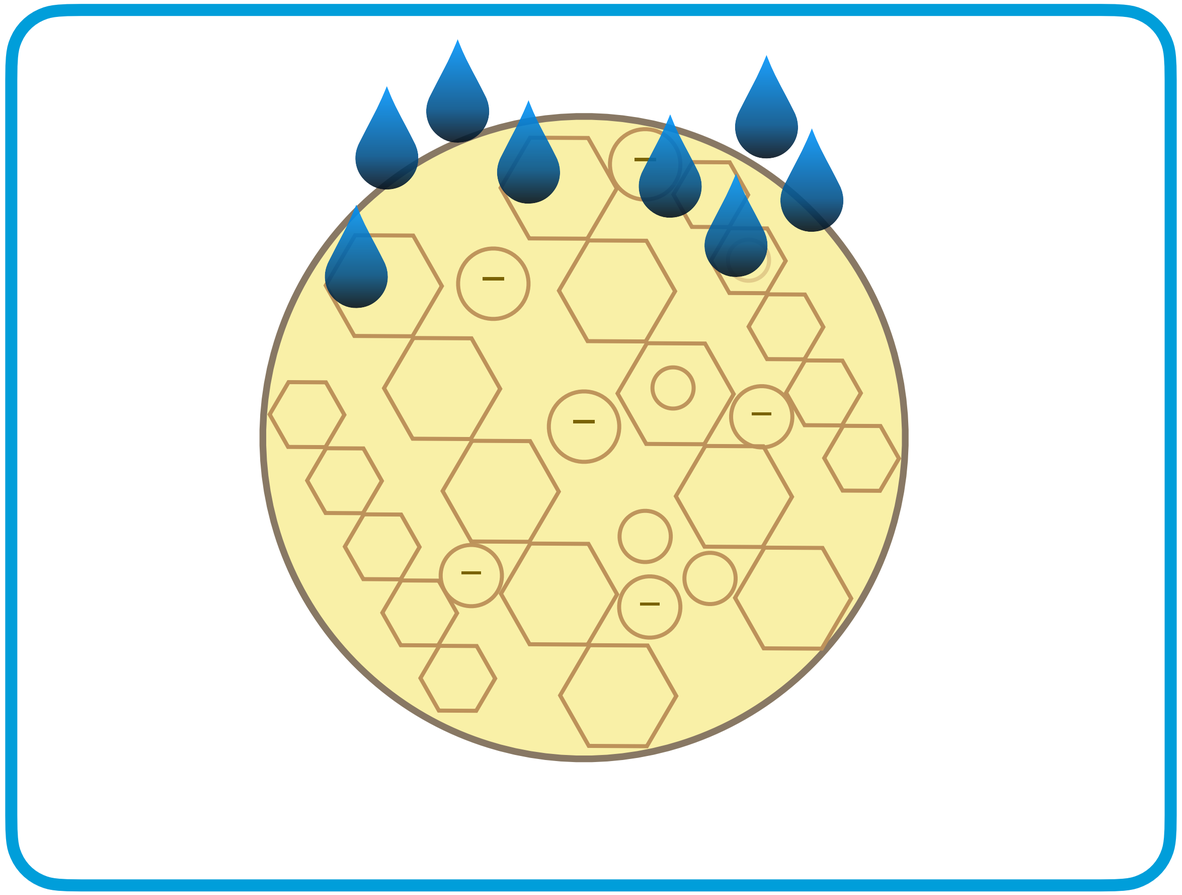
The Resin Bead in Action

Water contacts resin beads. Beads are 50% water.



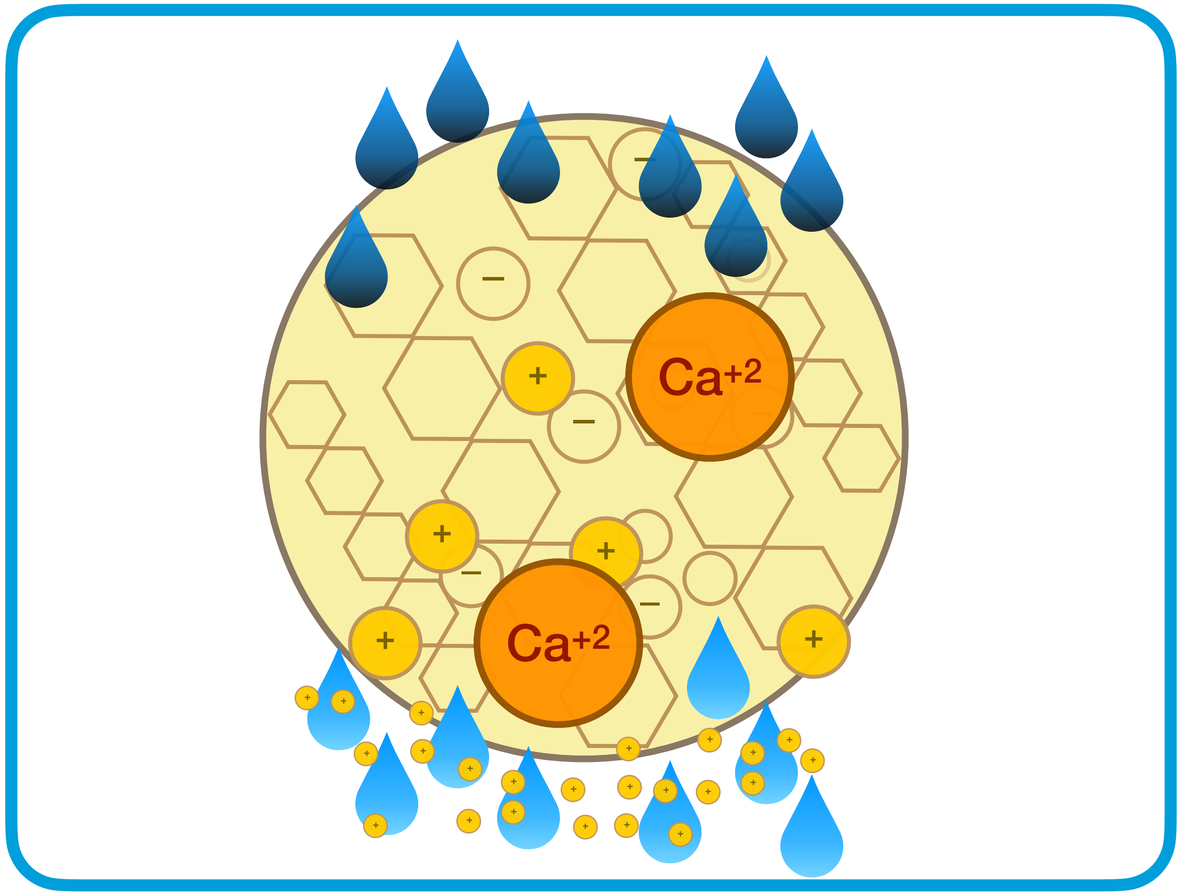
The Resin Bead in Action

Water containing unwanted ion, in contact with water inside beads, allows ions to diffuse in/out of beads.



The Resin Bead in Action

Hydrogen ions are exchanged and exit producing improved water.



Definition of Ions

- Cations – Positively charged ions dissolved in solution
- Anions – Negatively charged ions dissolved in solution
- Law of Electroneutrality – In any solution the number of cations equals the number of anions

Selectivity

- The attraction, of one ion over another, to an ion exchange resin
- Function of ion charge, size and concentration
- For SACs and SBAs:
  - Bigger the ion, higher the charge, the more selective the ion becomes
  - I.e. -3>-2>-1 and +3>+2>+1

Basic Products

- Cation Resins (CGS)
- Anion Resins (SBG1P)
- Mixed Bed Resins
- Selective Resins & Zeolites (SIR-300)

Cation Resins

- Used to remove cations from water
  - Hardness, Heavy Metals or all cations
- Strong Acid Cation (CGS)
  - Typically use Na^+ or H^+ forms
- Weak Acid Cation
  - Typically use Na^+ or H^+ forms

Common Cations

Iron	Fe^{2+}
Calcium	Ca^{2+}
Magnesium	Mg^{2+}
Sodium	Na^{+}
Potassium	K^{+}
Hydrogen	H^{+}

Anion Resins

- Used to remove anions from water
  - Complexes, oxy anions (Cromate, Sulfate, etc.)
- Strong Base Anion (SBG1P)
  - Typically use Cl^- or OH^- forms
- Weak Base Anion
  - Typically use Cl^- or free base forms

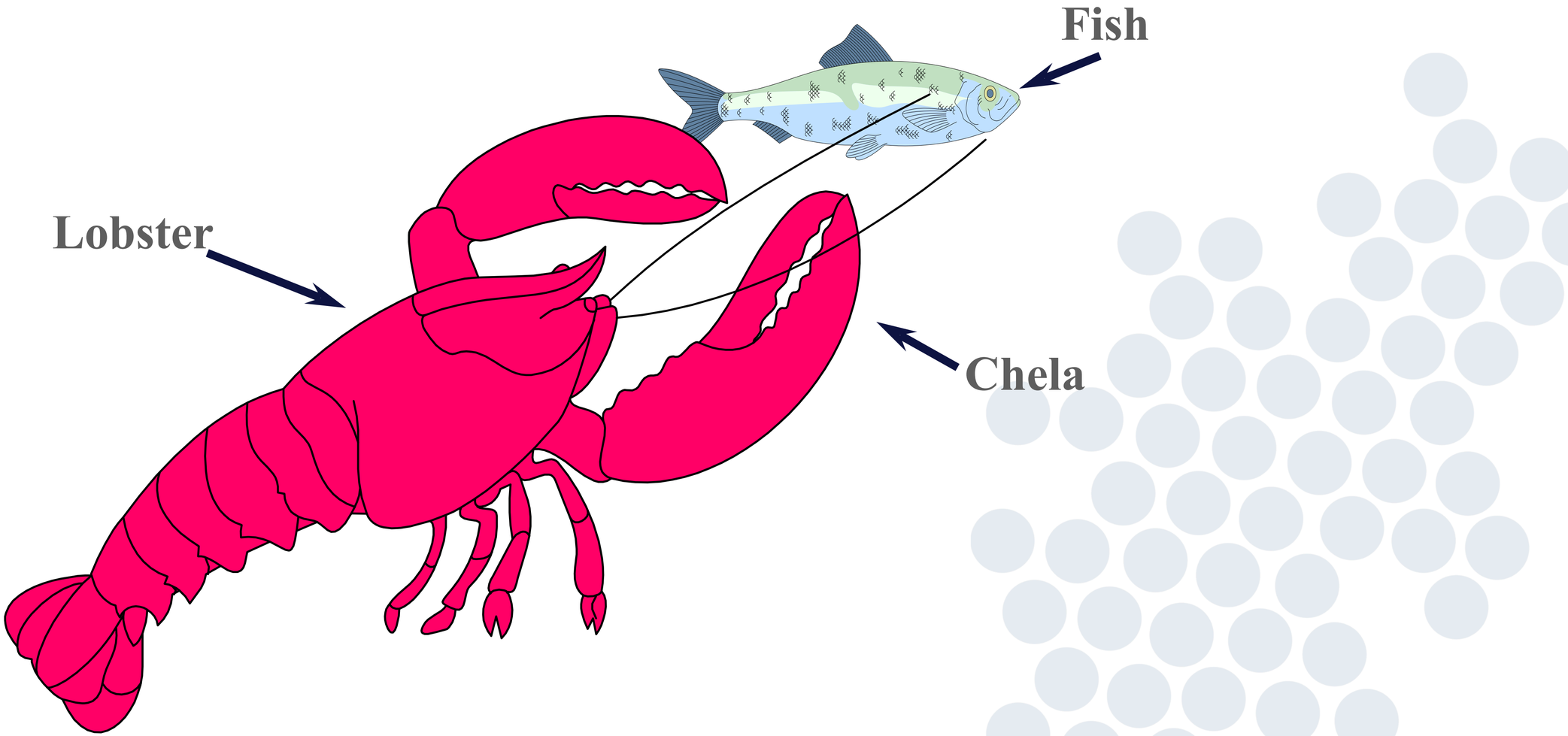
Common Anions

Phosphate	PO_4^{-3}
Sulfate	SO_4^{-2}
Nitrate	NO_3^-
Chloride	Cl^-
Bicarbonate	HCO_3^-
Hydroxide	OH^-

Selective Resins & Media

- Used to remove various ions from water
  - Heavy metals most common
- Chelating Resins
  - Typically use Na^+ or H^+ forms
  - Many types
- Ignores hardness and TDS
  - “pluck” metals out of water

Chelating Lobster (SIR-300)



Resin Selection

- Feedwater analysis
- Desired effluent quality
- Operating conditions
- Economics
- Type of equipment
- Regeneration chemicals if available

What do we need to Know?

- Viability of ion exchange
  - TDS (or conductivity)
  - pH
  - Basic inorganic analysis of ions (Ca, Mg, Na, Cl, SO4)
  - Presence or absence of oxidants (air?)
  - presence or absence of complexing agents
  - TOC
  - Suspended Solids (TSS)

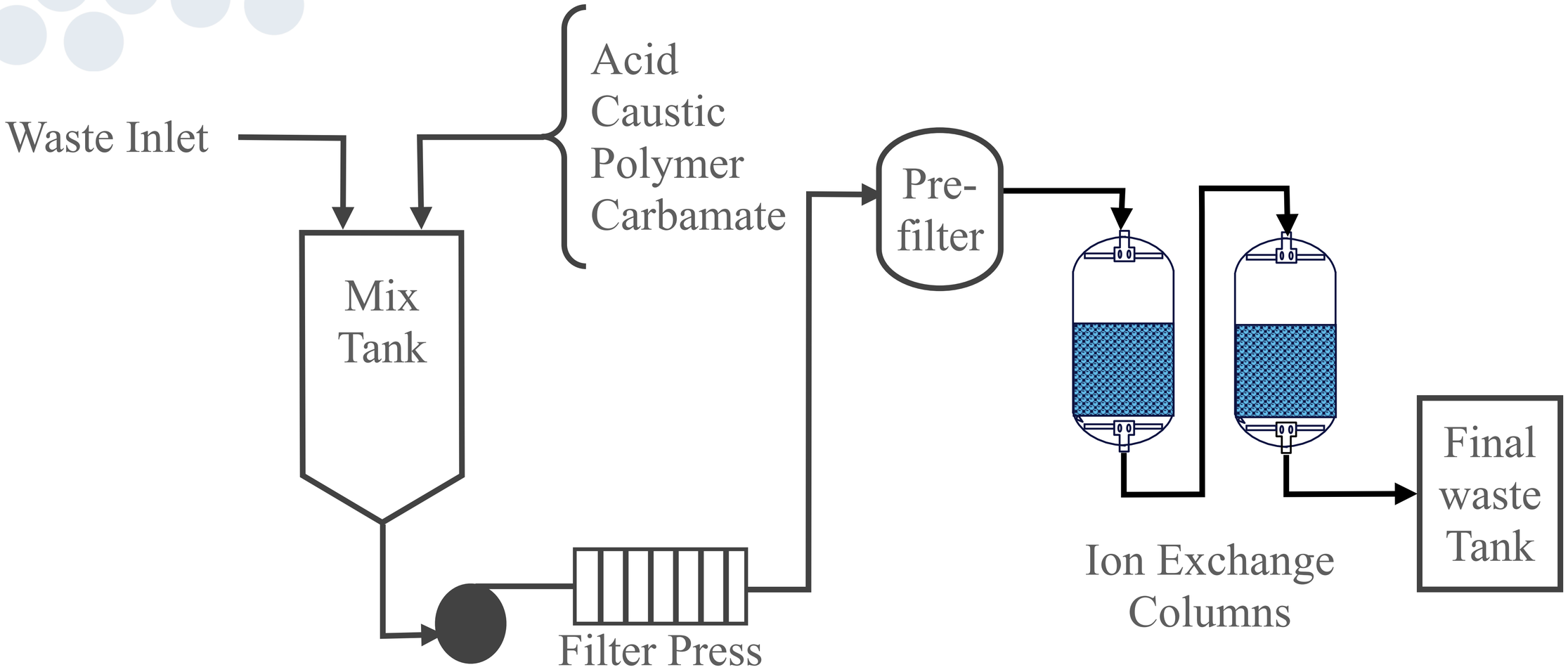
TDS Limits of various Resins Used for Metals Removal

- Strong Cation Resin (Hydrogen form) 500 ppm
- Strong Cation Resin (Sodium form) 2,000 ppm
- Weak Cation Resin (Sodium form) 15,000 ppm
- Chelating Cation Resin (Sodium form) no limit

Application Information

- CGS & SBG1P will be you main products
  - Apply at 2-5 GPM/Cuft
  - Need at least 20 bed volumes (150 gal/Cuft) before sampling (mainly due to VOC throw)
- SIR-300 (less often used, brackish waters)
  - Apply at 1-2 GPM/Cuft
  - pH issues need to be addressed
- TSS must be controlled (<0.5 ppm ideal)

Bulk Waste Treatment Schematic



The Capacity Question…

- More information the better
- Estimations are as good as the data provided
- Always given in good faith, most times it’s a best guess
- Cover yourself!!

THANK YOU

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