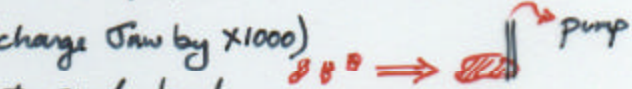
4.1 Alkali Soil Washing

Inject { Sodium Carbonate Na_2CO_3
Sodium Hydroxide $NaOH$ ← strong alkali and ∴ good results

Removal mechanisms:

1. Creates natural surfactant — due to alkali–NAPL– reactions
2. Precipitate Ca and Mn salts ↓ water hardness ↑ interfacial activity
3. Reduces surfactant adsorption onto aquifer mineral materials
4. Changes NAPL wettability (change σ_{nw} by ×1000)
5. Coalescence of NAPL ganglia into single bank and pump as single bank (phase)
6. Creates an emulsion of mixed material with small droplets



contradictory?

Processes:

Differs from surfactant flooding: { Alkali
Surfactant

processes operate @ front only.

Alkali | NAPL

Surfactant injection may be multiply pulsed.

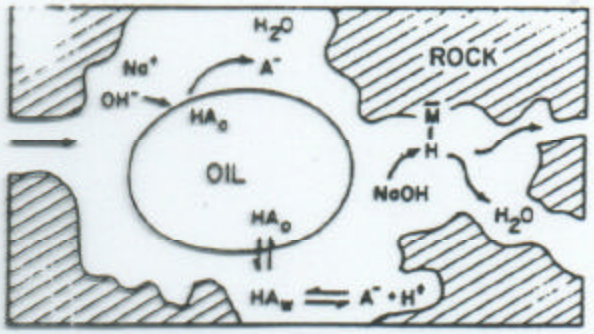
Applicability/Limitations

Most DNAPLs do not contain acidic components ∴ → no in situ saponification results ∴ surfactants must be supplied.

Decreasing σ may give downward vertical migration

Environmental applications — surfactants more toxic than DNAPL.
— not problematic for oil reservoirs.

Alkalis reduce water viscosity ∴ promotes unfavorable mobility ratios and prevents displacement processes.



Compatability issues (were alkali/cosolvent/surfactant used).

- interaction of alkali & soils or pore fluids by dissolution and attenuation of effect (esp. clays)
- pore clogging with dissolved precipitates

Ultimate pore fluids may have high pH and need treatment to neutralize.

Cost and Availability

Hardware readily available

Much experience in petroleum but few for envt. apps.

Successful application using surfactants and alkalies completed.

For DNAPL, use surfactants to augment lack of saponification

No envt. cost info available.