Emulsions

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Emulsions – physical-chemical drivers

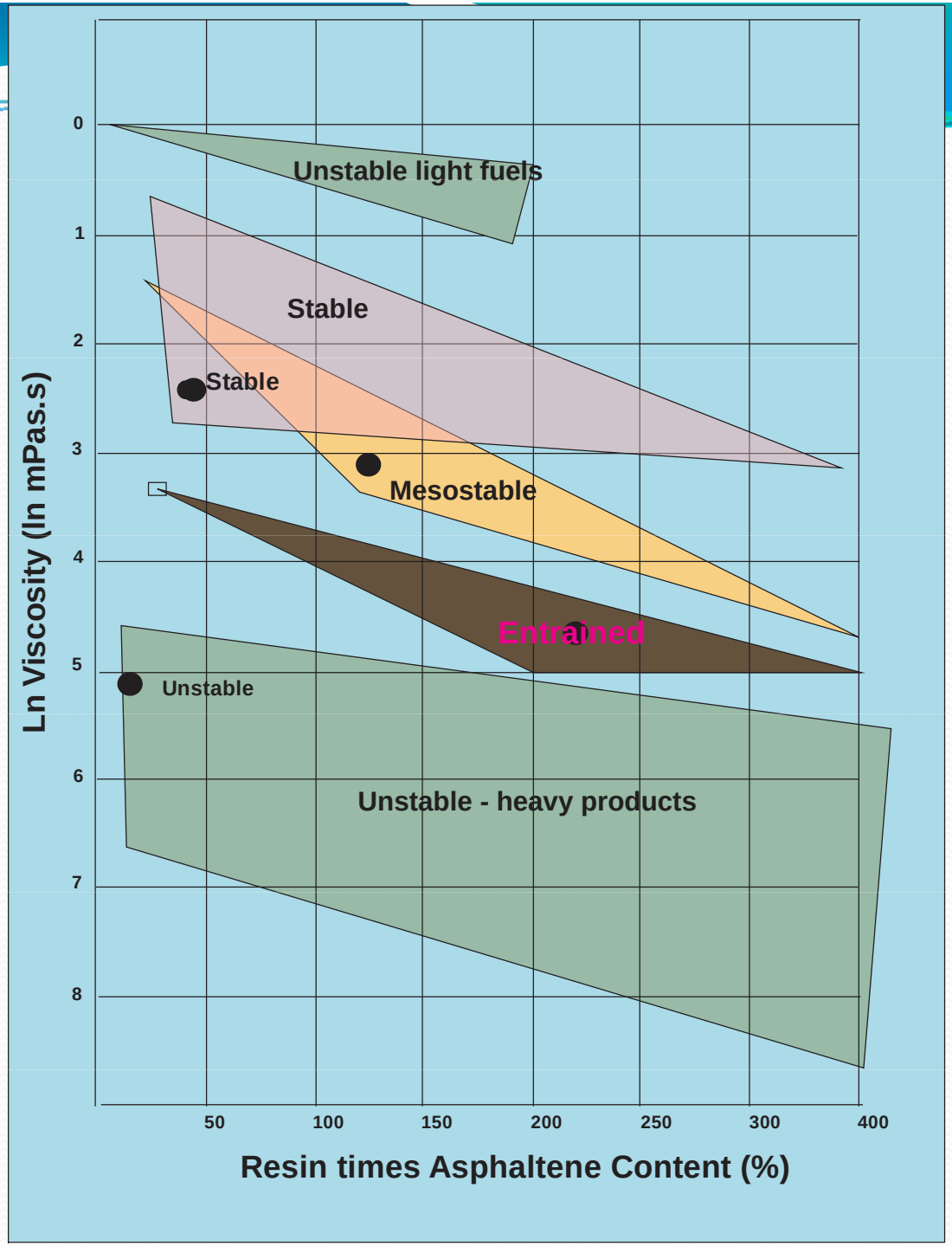
- Water-in-oil emulsions represent a new chemical form
- Rapidly formed when chemical conditions are right and sufficient sea energy
- 3 types formed - stable, meso-stable and entrained water (no inter-conversion)
- Lifetimes Stable up to years, meso-stable - 1 to 5 days, entrained - with sea energy then 1/2 day

Towards modeling - - - -

- Necessary ingredients - right chemical composition (A,R, a/r)- viscosity - weathering - sea energy
- Right chemical composition - different for each of 3 types - combination of viscosity, asphaltene and resin content - almost all oils need weathering (evaporation) before will form types
- Formation chemistry - water uptake, stabilized somewhat by viscosity, then stabilized by resins and asphaltenes
- Kinetics not entirely solved but appear to be rapid
- Entrained - water droplets stabilized largely by oil viscosity - most applicable to higher viscosity oils
- Variability in characteristics of asphaltenes and resins, implies overlap in oils and states

Model Options

- **A.** 'water uptake models' not accurate (assumes only a 1st order uptake in all oils), need a 'state' model
- **B.** use empirical data - accurate, data exists for over 400 oils at various weathering stages, could predict for oils not in set
- **C.** Fuzzy and other advanced logics (ANFIS)- accurate - but difficult to implement in typical models
- **D.** Regression models - ok - can be implemented inside existing models - inputs: viscosity, asphaltene and resins (plus entire SARA) – some overlap


Unstable light fuels
Stable
Stable
Mesostable
Entrained
Unstable
Unstable - heavy products
Ln Viscosity (ln mPas.s)
0
1
2
3
4
5
6
7
8
50
100
150
200
250
300
400
Resin times Asphaltene Content (%)