EOR additives from local sources

Dr.Mariyamni Awang

Dr.Wan Aizan Wan Abd. Rahman

Faculty of Chemical & Natural Resources Engineering

Universiti Teknologi Malaysia, Skudai, Johor

Local production of EOR chemicals

Successful polymer flooding and ASP flooding at Daijing fields used chemicals made specifically for EOR

Malaysia is rich in organic resources

Research policy encourages study on the processing of raw materials

Our research investigates on how to reduce the cost of chemical additives by producing the chemicals locally and using as much local sources as possible

Choice of chemicals

- Xanthan was chosen because it has been used in a wide range of industries, none is produced locally, local renewable sources can be used and it has been extensively tested.
- Polymannan from a bacillus licheniformis that was isolated from the formation water of a Malaysian reservoir
- Surfactants or fine chemicals from a pyrolytic oil

Production of xanthan

- Xanthan is produced from a fermentation process using xanthamonas campestris microbes.
- A carbon source such as corn syrup and small amounts of other substances are needed: KCl, yeast extract etc.
- In the US corn syrup is the main carbon source used because the US is the biggest corn producer. Malaysia has many forms of starches which are mainly used for food.

Local Starches

- Sago and tapioca
- Malaysia is a net importer of rice but mill waste that contains rice lost during milling is a possible source

Xanthan production processes

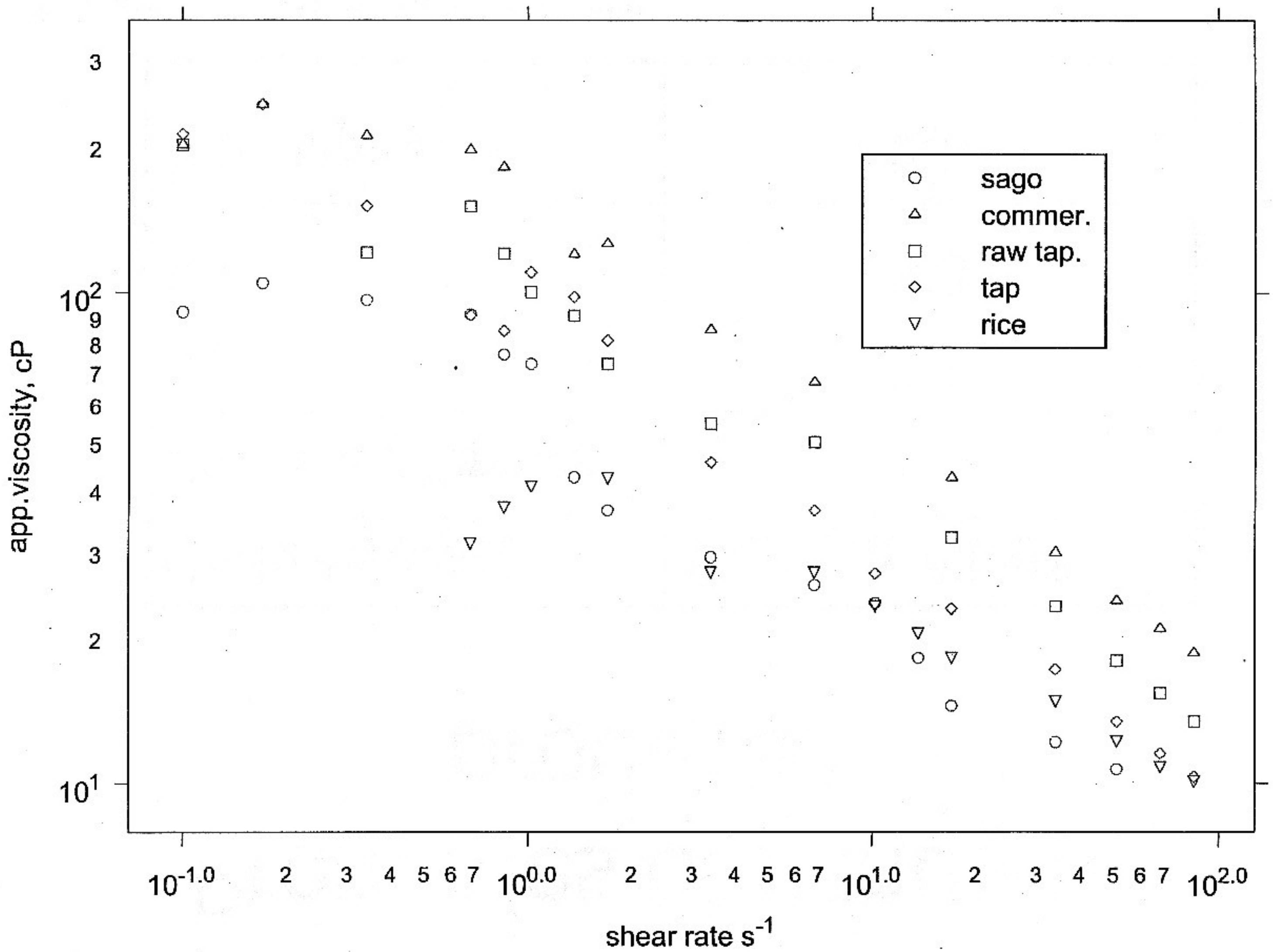
- 1) Build up a colony of microbes
- 2) Mix the colonies of microbes and nutrients
- 3) Ferment for 48 hours
- 4) Filter off dead cells and other solid metabolic products
- 5) Recover xanthan as gel from the filtrate using ethanol (40-50 % of the cost)
- 6) Dry the xanthan gel
- 7) Purify if necessary by redissolving in ethanol and drying

Properties of xanthan produced

Carbohydrate	Yield gm/litre*
Processed tapioca	5.3
Sago	6.5
Rice	4.3
Raw tapioca	5.9

* Xanthan plus byproducts

Fig 1. APPARENT VISCOSITY vs SHEAR RATE



Rheology measurements

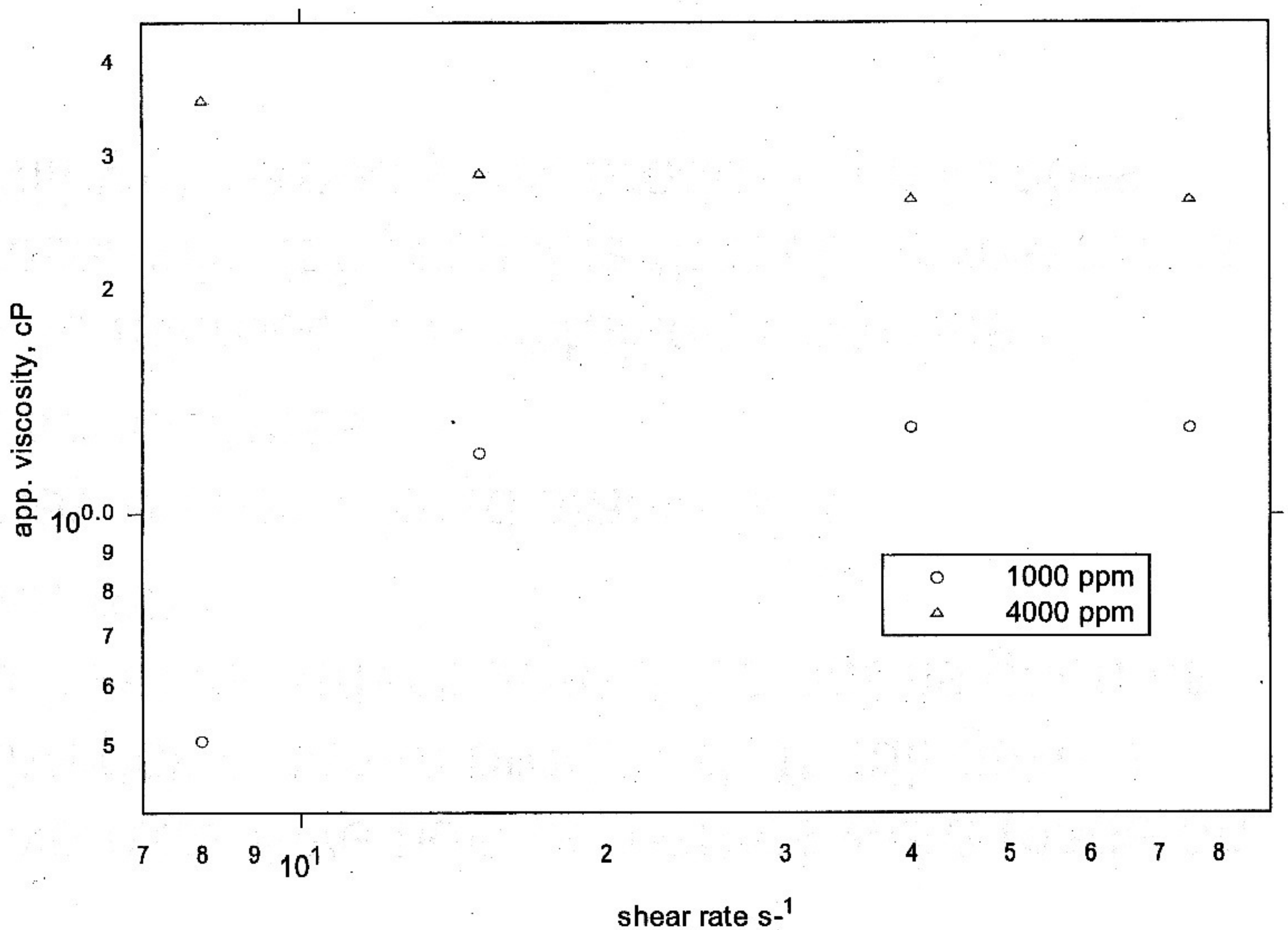
- Adsorption
- Crosslinking
- Displacements
- Lower resistance to biological degradation but may be overcome with biocides
- Overall the xanthans were comparable to the commercial xanthan

Polymannan*

- Microbes isolated from a reservoir are expected to withstand reservoir conditions and may be useful for MEOR. What are the properties of the produced substance? Can it be extracted and be reinjected?
- Exopolysaccharide which is a byproduct of the metabolism of bacillus licheniformis S20A
- Melts at 124.5 °C, degradation at 200 °C (xanthan degrades around 250°C)
- Molecular weight varies from 1.7×10^5- 1.54×10^6 (close to xanthan)
- Weak viscosifier : Fig 2

*(Wan Aizan's group)

Fig 2. APPARENT VISCOSITY vs. SHEAR RATE



- No extensive flow properties were made on the polymannan produced. It still gave a thickening effect even if it's not as good as xanthan.
- May be considered stable at high temperatures
- The microbe was obtained from one reservoir. It's probable that other reservoirs will yield biopolymer producing microbes

Production of sulphonates from pyrolytic oil *

- Waste of oil palm industry
- Composition: more than 70 % acetic acid and phenol
- Drawback ...needs high T to produce it.

* In association with Prof Farid Nasir's group

Conclusions

- In general, cheap local renewable sources can be used to produce chemicals for EOR
- Produce value added products

Acknowledgement

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