

# Discussion of Filtration Experiments in Niobrara Samples

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### **Problem Statement**

Pore sizes of Niobrara samples are in nano range

Pore/throat  $\xleftarrow{Same \ order \ of \ magnitude}{}$  Hydrocarbon molecule

Nanoporous material can act as a semi-permeable membrane



Light components can pass through

Heavy components may be completely or partially filtered



### Objective

- Explore the membrane property of Niobrara sample
- Investigate factors controlling the membrane effect of Niobrara sample
  Pressure Adsorption (rock/fluid interaction)
  Temperature Diffusion
  Migration distance (sample length) ...
  - Hydrocarbon molecular size

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In-Line Filter

Pressure: 0-2500 psig Temperature: -20 °F to 100 °F







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#### Niobrara Sample

0.5 in -



0.8 in





Seal ability Test

Epoxy is hydrocarbon proof No leakage under experimental condition,

•  $nC_6 + nC_{10}$  injection

injected fluid: Equal-volume mixture of  $nC_6$  and  $nC_{10}$ 60%  $nC_6$  40%  $nC_{10}$  (mole fraction) produced fluid: 35%  $nC_6$  65%  $nC_{10}$  1% other

•  $nC_7 + nC_{10}$  injection

injected fluid: Equal-volume mixture of  $nC_7$  and  $nC_{10}$ 57.09%  $nC_7$  42.91%  $nC_{10}$  (mole fraction) produced fluid: 45%  $nC_7$  54%  $nC_{10}$  1% other







 Possible reason of the decrease of nC<sub>7</sub> in the produced fluid – preferential adsorption.



Henry adsorption constants of  $C_1 - C_{14}$  n-alkanes on SAPO-34 (zeolite) (Denayer et al, 2008)



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- Possible reason of the decrease of nC<sub>7</sub> in the produced fluid.
  - Preferential adsorption depends on 1) chemical nature of the adsorbent/adsorbate 2) relative size between n-alkanes and pore/throat
  - Zeolite: silicon-rich mineral
     e.g. Na[AlSi<sub>2</sub>O<sub>6</sub>]·H<sub>2</sub>O Ca[Al<sub>2</sub>Si<sub>3</sub>O<sub>10</sub>]·3H<sub>2</sub>O
     Å ~ nanometer pore/throat
  - Niobrara sample: calcite-rich moderate silicate (clay, quartz)
     Å ~ nanometer pore/throat



Niobrara mineralogy ternary plot (Saidian et al 2016)



### Conclusion

- Filtration experiments were conducted using n-alkane mixtures
- Heavy component (nC<sub>10</sub>) was found to be increased in the produced fluid.
- Preferential adsorption of shorter n-alkanes (nC<sub>6</sub>/nC<sub>7</sub>) over longer ones (nC<sub>10</sub>) in the Niobrara sample may account for the observed result.
- Influence from adsorption should be considered in the future work
- Subsequent experimental data needed to help investigate the membrane property of Niobrara sample.



## Thank You Questions?

