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APPENDICES

Appendix A Onset Point of GM3 Crude Oil

As mention in 4.1, the onset point of GM3 was around 50 vol% C7. Micrographs of GM3 can be seen is Figure A1. Precipitated asphaltene was in the circle.

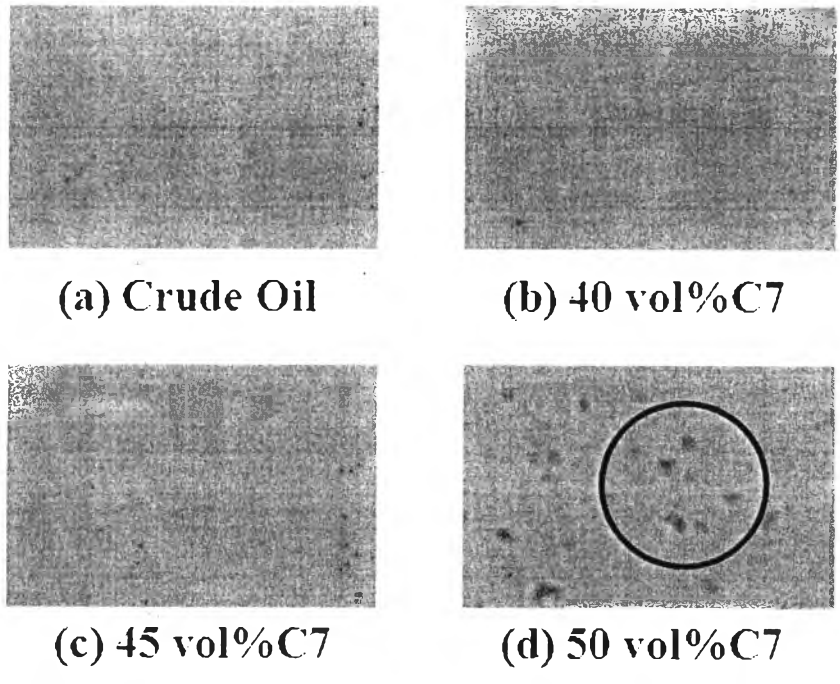

Figure A1 Micrographs showing the pictures of GM3 and precipitant's solution effluent of different concentrations.

Appendix B All Apparatus Pictures

There were six types of apparatus that we used in this work.

B1 Normal Setup (Uses with CH Crude Oil Experiment)

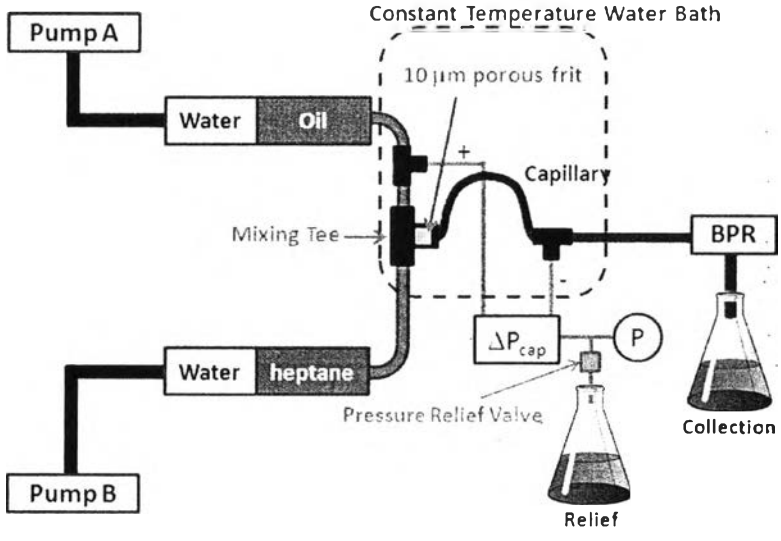

Figure B1 Asphaltene deposition apparatus (Normal setup: using mixing frit to help mixing).

B2 Modification 1 (Uses with CH Crude Oil Experiment)

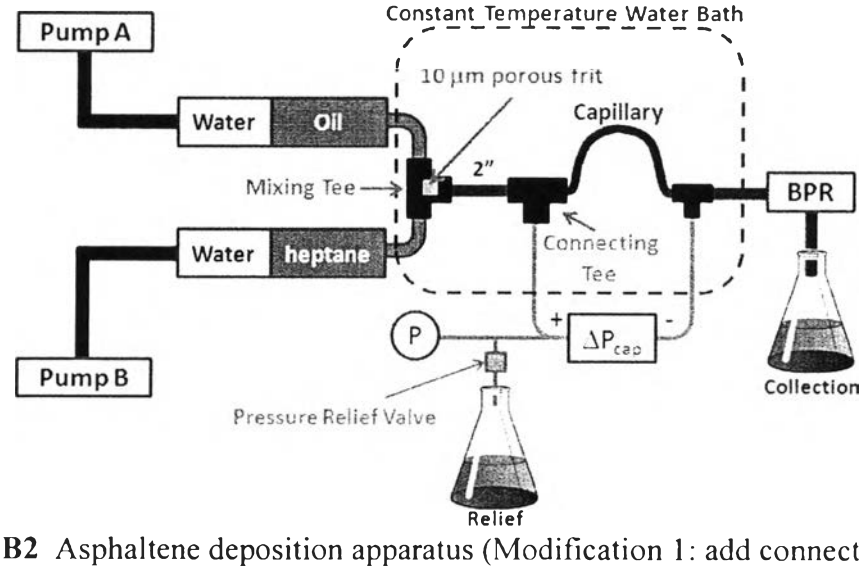

Figure B2 Asphaltene deposition apparatus (Modification 1: add connecting line).

B3 Modification 2 (Uses with CH Crude Oil Experiment)

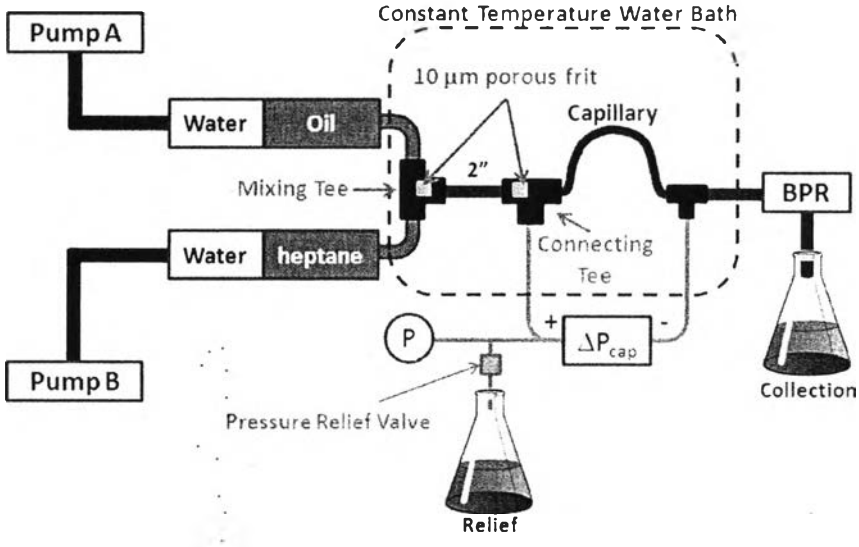

Figure B3 Asphaltene deposition apparatus (Modification 2: pre-filter was added).

B4 Modification 3 (Uses with CH and GM3 Crude Oil Experiment)

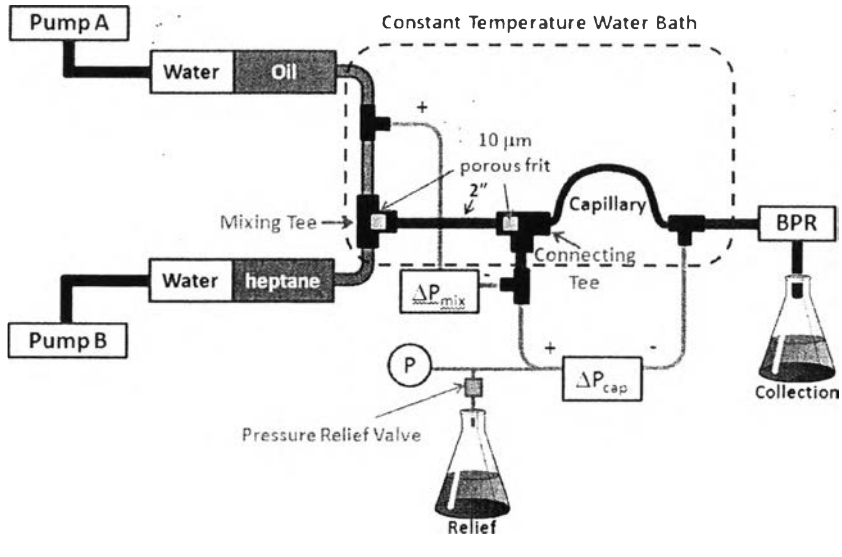

Figure B4 Asphaltene deposition apparatus (Modification 3: connected second pressure transducer).

B5 Modification A (Uses with GM3 experiment)

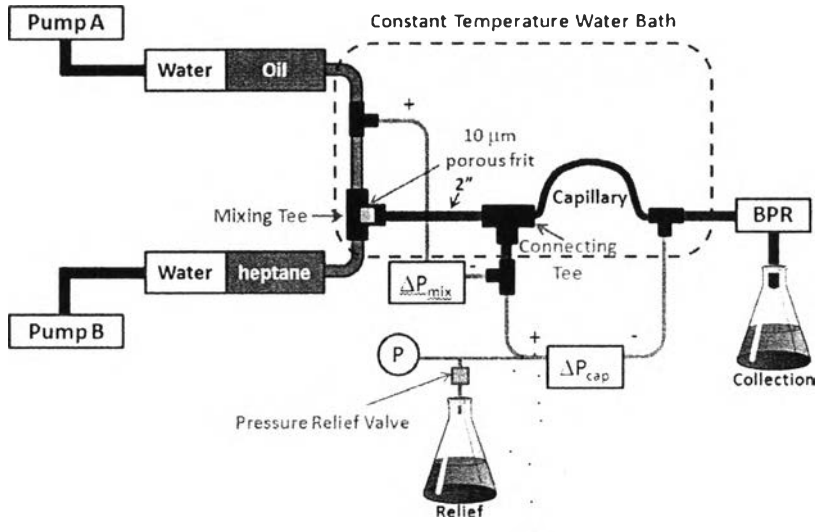

Figure B5 Asphaltene deposition apparatus (Modification A: removed pre-filter from connecting tee compares to Normal setup for GM3).

B6 Modification B (Uses with GM3 experiment)

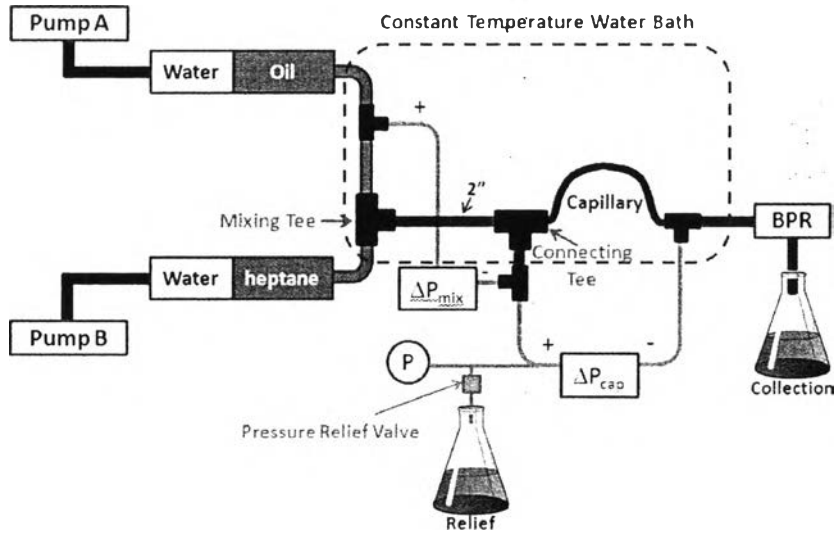

Figure B6 Asphaltene deposition apparatus (Modification B: removed mixing frit from mixing tee compares to Modification A).

For GM3 experiment, the experiments were done with the apparatus which second pressure transducer was connected, same as Modification 3 (Normal setup for GM3). Modification A and Modification B contained no frits and only mixing frit respectively. Both of them counted as fifth and sixth type of this work.

Appendix C Residence Time Calculation

From equation 6, we need to know the details of every part in apparatus to calculate the residence time. The properties of our apparatus can be seen in Table B1.

Table C1 Properties of components in apparatus

Properties	Frit	Connecting line	Capillary
Shape	Cylinder	Cylinder	Cylinder
Radius (in)	0.031	0.015	0.005
Long (in)	0.062	2	12
Porosity	0.35	1	1

Example of frit's residence time calculation:

$$\text{Residence Time} = \text{Porosity} * \frac{(\pi r^2 L)}{\text{Flow Rate}}$$

$$\text{Residence Time} = 0.35 * \frac{(\pi * 0.031^2 * 0.062)}{5} \frac{in^3 \cdot hr}{mL} * \frac{2.54^3}{1} \frac{cm^3}{in^3} * \frac{1}{1} \frac{mL}{cm^3}$$

$$\text{Residence Time} = 0.000215\, hr * \frac{3600}{1} \frac{s}{hr} = 0.773 \text{sec}$$

CURRICULUM VITAE

Name: Mr. Varun Chuenmeechao

Date of Birth: August 21, 1986

Nationality: Thai

University Education:

2005-2009 Bachelor Degree of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

Work Experience:

2008 Position: Student Internship

Company name: Woraporn Company, Thailand

Proceedings:

1. Chuenmeechao, V.; Malakul, P.; Hoepfner, M. and Fogler, H.S. (2011, April 26) Validation and Standardization of Asphaltene Deposition by Capillary Experiments. Proceedings of The 2nd Research Symposium on Petroleum, Petrochemicals, and Advanced Materials and The 17th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Queen Sirikit National Convention Center, Bangkok, Thailand