

Facilities

EOGRRC labs are equipped with a broad range of instruments for research projects, routine tests/services and simulation work.

1. Analytical and Characterization Instruments

- [Multiple Gas #3 GC](#)
- [Simulated Distillation Analyzer \(450-GC\)](#)
- [DV-11+ Pro Viscosimeter](#)
- [DDM 2910 Digital Density Meter](#)
- [J257 Digital Refractometer](#)
- [Microscopes](#)
- [FiveEasy™ pH Meter](#)
- [Rotavapor R-210](#)

2. Auxiliary Equipment

- [POLYTRON PT 10-35 GT Homogenizer](#)
- [Misonix Sonicator S3000](#)
- [MisonixMICROSON XL2000](#)
- [High Pressure Syringe Pumps](#)
- [Other Syringe Pumps](#)
- [Balances](#)
- [Heating Ovens](#)
- [Small Benchtop Muffle Furnace](#)
- [Centrifuge](#)
- [Vacuum Pump](#)
- [Stirring Hot Plates](#)
- [Foldable Shop Crane](#)
- [Bench Visers](#)
- [Core Cutting Machines](#)
- [Core Holders](#)

- [Soxhlet Extractors and Dean-Stark Apparatus](#)

3. Test/Masurement Systems and Setups

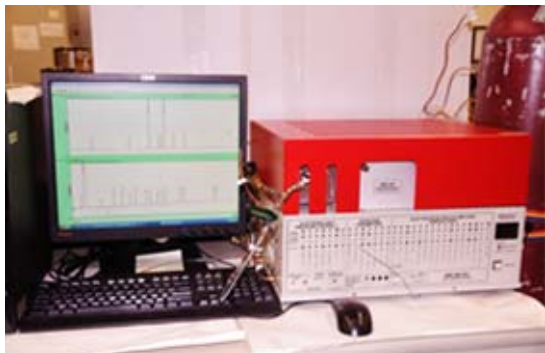
- [Core Flooding System](#)
- [HP-HT CO₂ Injection Test System](#)
- [Steam Injection Test System](#)
- [Oxidation/Diffusion Test System](#)
- [HP-HT Pendant Drop Interfacial Tension \(IFT\) System](#)
- [Micro-model Visualization Setup](#)
- [HP-HT Mini Bench Top Reactor](#)
- [PVT](#)
- [SARA Analysis Setup](#)

4. Computational/Simulation Lab

The Simulation Lab is equipped with an [Inexpensive Interactive Immersive Interface Station for 3D Visualization](#) and workstations. We hold the licenses of the most recent versions of the following software packages for our research:

- PETREL/ECLIPSE - RESERVOIR SIMULATOR
- CMG - RESERVOIR SIMULATOR
- FRACA - FRACTURE NETWORK ANALYSIS AND SIMULATION
- MFRAC/MSHALE – HYDRAULIC FRACTURING SIMULATOR

Multiple Gas #3 GC



The Multiple Gas #3 is a SRI 8610C Gas Chromatograph system. It is used for the analysis of gases such as oxygen, nitrogen, carbon mono/dioxide, and other non hydrocarbons or hydrocarbons, or simple mixtures.

Two packed columns are in use: a 2 meter Haysep-D column and a 2 meter MoleSieve 13X column.

Features:

- Detector: combined TCD/FID
- Temperature control: Programmable
- Gas flow control: Electronic pressure control

Simulated Distillation Analyzer (450-GC)



The Simulated Distillation (SimDist) Analyzer (Bruker Chemical Analysis) is a highly automated 450 GC, controlled by CompassCDS software integrated SimDist software. It is capable of reproducing the physical distillation of petroleum materials and products such as distillates, blends, fuels, residues and crude oil, ranging from carbon number C1 to C120 by determining boiling point distribution up to 750 °C, delivers fast, accurate standard test method results.

The CompassCDS SimDist software incorporates all of the ASTM, DIN, IP and ISO methods associated with Simulated Distillation analysis, which provides a quantitative percent mass yield as a function of boiling point of the hydrocarbons of the sample.

Features:

- Dual high temperature FID detector, temperature programmable up to 450 °C
- Dual injector, 1079 PVT injector for light gas oil and 1093 COC injector for high temperature boiling point distribution
- CP-8400 autosampler accommodates up to 100 samples using 2 ml vials

DV-II+ Pro Viscosimeter



The Brookfield Programmable LVDV-II+ Viscometer is capable of making a rapid measurement of absolute viscosity of fluid in small sample volume. It continuously senses and displays viscosity, temperature, % torque and speed (rpm).

Features:

- Cone spindle: CPE-40 and CPE-51
- Measurement range: At 0.1-200 rpm, CPE-40 (0.15-3056 cp); CPE-51 (2.4-47990 cp)
- Sample volume: 0.5 ml
- Working temperature: 0-100 °C

DDM 2910 Digital Density Meter



The DDM 2910 Density Meter (RUDOLPH Research Analytical), with high precision Peltier, has the features to meet the needs of many industries such as petroleum, chemical, pharmaceutical and beverage for the measurement of density, specific gravity and concentration for liquids and gases.

Features:

- Measurement range: Density: 0 to 3 g/cm³
Temperature: 0 °C to 95 °C
- Measurement Modes: Continuous, Single, Multiple;
- Resolution: Density: 0.00001 g/cm³
Temperature: 0.01 °C
- Minimum Sample Volume: Less than 1mL

J257 Digital Refractometer

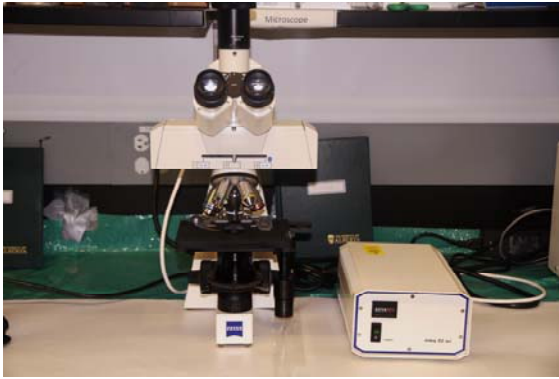


J257 Digital Refractometer (Rudolph Research Analytical) is a fully Automatic Digital Refractometer, featuring electronic cooling and heating with an extended refractive index (RI) measurement range. This instrument is capable of measuring many materials.

Features

- Measurement Range: 1.26 – 1.70 RI; 0 – 100 BRIX
- Resolution: 0.0001 RI; 0.01 BRIX
- Optical wavelength: 589.3 nm
- Temperature control range: 15-70 °C

Microscopes



AxioStar Plus Upright Microscope
(Carl Zeiss)



Axioskop Upright Microscope
(Carl Zeiss)

Two fluorescent upright microscopes are available:

AxioStar Plus Upright Microscope (Carl Zeiss) is equipped with a fluorescence module for reflected-light illumination. A filter slider permits up to three fluorescence cubes to be used simultaneously. Fluorescence excitation is provided by the proven HBO 50 mercury lamp.

Magnification range of it is 5x, 10x, 20x, 40x, and 100x.

Axioskop Upright Microscope (Carl Zeiss) has a magnification range of 4x, 10x, 40x, and 100x.



Stemi 2000-C stereo Microscope
(Carl Zeiss)

Stemi 2000-C stereo Microscope (Carl Zeiss) produces three-dimensional, laterally correct and upright images. The objects examined are reproduced in a true-to-life way with an outstanding impression of depth. Its major benefits include large object fields and large working distances.

Magnification range: 0.65x - 5.0x

All three systems can be equipped with a 3.2MP Firewire or a Digital SLR camera for image processing.

FiveEasy™ pH Meter FE20

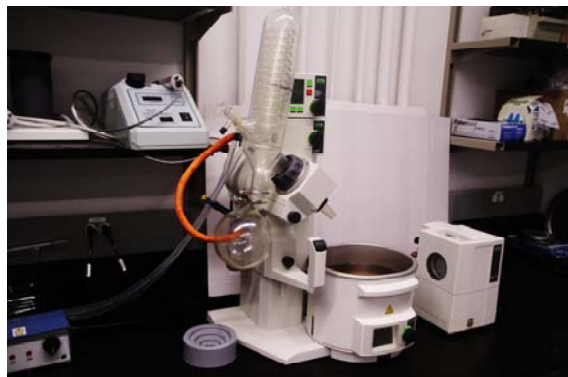


This compact pH meter gives rapid and reliable results. It is suitable for a wide range of applications in various areas, such as water and environmental analysis, as well as the food and beverage industry.

Features:

- Measurement range: pH 0.00-14.00, 0-100 °C
- Resolution: 0.01 pH

Rotavapor R-210

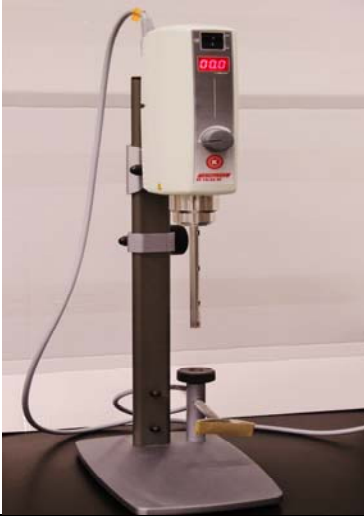


The lab-scale Rotavapor R-210 (BUCHI) can be used for separating solvent from product. It comes with vacuum controller, vacuum pump and recirculating chiller allows you to evaporate your solvents in the most efficient and gentle way. The heating bath, for water or oil, covers a wide temperature range from 20 – 180 °C. A large, clear graphic display continuously shows the actual temperature and the temperature setpoint.

Features

- Vacuum Controller V-850 for vacuum regulation to a specified setpoint
- Flask size: 50 – 4000 ml
- Rotation speed: 20 - 280 rpm

POLYTRON PT 10-35 GT Homogenizer



The Kinematica Polytron Benchtop Homogenizer, Model PT 10-35 GT, can be used to process emulsions, suspensions and foams by reducing the size of solid particles, droplets and gas bubbles to a few microns or less.

Features:

- Speed(max.): 30,000 rpm
- Tip speed (max.): 14 m/s
- Working volume: 3-250 ml

Misonix SONICATOR S3000



The SONICATOR S3000 is a powerful, versatile ultrasonic liquid processor. It is capable of mixing compounds and solutions, generating fine emulsions and suspensions, accelerating chemical reactions, degassing of solutions and analyzing soil samples.

Features:

- Max sample size: 40,000 ml
- Max. power output: 600 Watts
- Operating frequency: 20kHz

Misonix MICROSON XL2000



The XL 2000 is an economic alternative to the Sonicator 3000 when working with sample volumes of 0.2 ml to 100 ml.

Features:

- Max. power output: 600 Watts
- Operating frequency: 22.5kHz

High Pressure Syringe Pump



The 500D syringe pump (Teledyne ISCO, Inc.) provides precise, predictable flow and pressure control throughout a remarkable operating range. Exceptional low-flow stability at up to 3,750 psi makes this the ideal pump for high pressure applications such as deep well core analysis. Capable of operating in single pump independent mode, dual pump continuous delivery or receive mode.

Features:

- Flow range: 0.001-204 ml/min
- Pressure range: 0-3750 psi (0.7-258.6 bar)
- Cylinder capacity: 507.38 ml

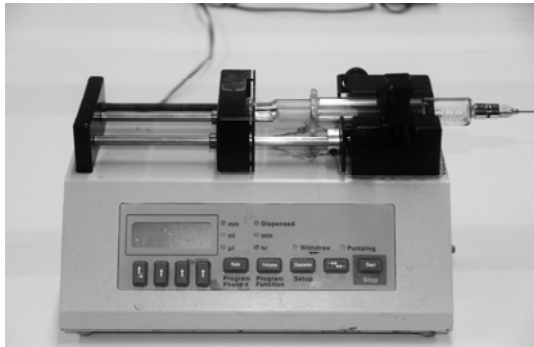
Other Syringe Pumps



This GenieTouch dual syringe pump (Kent Scientific Corporation) has precision infusion/withdrawal function, multi-syringe capability and easy-to-use touchscreen interface.

Features:

- Number of Syringes: Up to 4
- Syringe Size: 0.5 ul to 60 ml



This is a programmable syringe pump, model YA-12 Multi-Phaser (Yale Apparatus)

YA-12

Balances



NewClassic balance (METTLER TOLEDO)

- Weighing capacity: 220 g
- Readability: 0.0001 g



Explorer Pro balance (OHAUS)

- Weighing capacity: 410 g
- Readability: 0.001 g



DeltaRange balance (METTLER TOLEDO)




- Weighing capacity: 3100 g
- Readability: 0.1 g



Sartorius Electronic Precision Scale (Sartorius)

- Weighing capacity: 6 kg
- Readability: 0.2 g

Heating Ovens

	<p>Mechanical Convection Oven (LR Technologies Inc.)</p> <ul style="list-style-type: none">• Operating range: ambient +5 °C to 260 °C (104 °F - 500 °F)
	<p>603 Mechanical Convection Oven (NAPCO Intl. Inc.)</p> <ul style="list-style-type: none">• Max temperature: 220 °C• Interior Dimensions: 36" W x 17" D x 23" H
	<p>LAC2-12-6 Bench Top Oven (Despatch Industries)</p> <ul style="list-style-type: none">• Operating range: 40 °C – 260 °C (104 °F – 500 °F)• Chamber size: 23.8" W x 24" D x 36" H



LAC2-18-6 Bench Top Oven (Despatch Industries)

- Operating range: 40 °C – 260 °C (104 °F – 500 °F)
- Chamber size: 35.3" W x 24" D x 36" H

Small Benchtop Muffle Furnace



The Small Benchtop Muffle Furnace (Thermo Scientific Thermolyne) is versatile and economical. It can be used for ashing organic and inorganic samples, determining volatile and suspended solids, gravimetric analysis, heat treating of small steel parts, and ignition tests.

- Maximum temperature: 1100 °C (2012 °F)

L-K Heating Centrifuge



Centrifugal force is used to develop pressure differences at the interface of two immiscible fluids such as oil and water. This Lab Model Melton Type Centrifuge is used to apply increasing centrifugal force or the displacement of liquid from water/oil saturated rock core samples.

Features:

- Electric heated cups
- Tube size: 100 ml long cone tube

Vacuum Pump

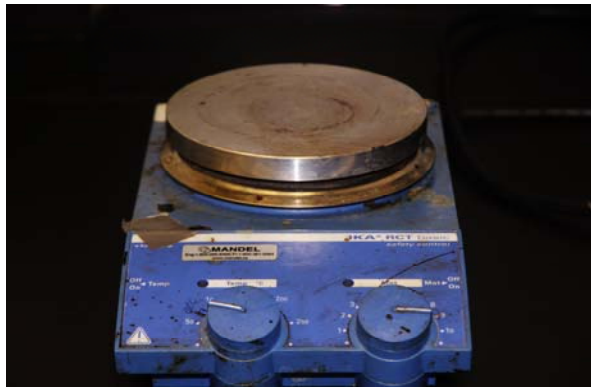


The Welch 1380DuoSeal vacuum pump is durable, which is used for creating vacuum system and pre-treating cores in vacuum chambers during the operation of saturating various cores with oils.

Features:

- Ultimate pressure: 5×10^{-4} Torr
- Free air displacement: 160 L/M, 5.6 CFM

Stirring Hotplates



IKAMAG RCT basic

Both stirring hotplates are the stirring instrument with heating function. Temperature and speed can be precisely controlled. The Fisher Scientific hotplate has solid ceramic tops resisting acids and alkalis.



Fisher Scientific stirring hotplate

Features:

- Max. surface temperature: 300 °C (IKAMAG RCT basic)
538 °C (Fisher Scientific)
- Max. operating speed: 1100 rpm (IKAMAG RCT basic)
2500 rpm (Fisher Scientific)

Foldable Shop Crane



Type: Quick lift shop crane

Capacity: 2 Ton

Bench Vises



The two bench vises with the jaw width of 4" and 6" are capable of securing heavy materials as well as small materials during hand operations.



Core Cutting Machines



PortaSaw MS 355



The PortaSaw MS 355 (Husqvarna) is used for wet or dry sawing of masonry and refractory materials such as brick and block.





The DS 280 drilling machine (Husqvarna) is an electric stand drill, intended for drilling holes in concrete, bricks and various stone materials.


Rated output: 120 V, 2400 W

Max. diameter drill bit: Low speed: 350 mm
High speed: 250 mm

Core Holders

The commercial or custom designed core holders with various lengths and internal diameters are used to perform fractured media experiments. Porous media choices are Berea sandstone, Indiana limestone, carbonate and real core samples.



	<p>RCHR-1.0 16.5" (L) x 1" (ID) Core length: 1-9" Working pressure:10000 psi Temperature:177°C(350°F)</p>
	<p>RCHR-2.0 16.5 (L) x 2" (ID) Core length: 1-9" Working pressure:10000 psi Temperature:177°C (350°F)</p>
	<p>RCHR-4.0 16.5 (L) x 4"(ID) Core length: 1-9" Working pressure:10000 psi Temperature:177°C (350°F)</p>
	<p>RCHR-2.0 28.75" (L) x 2" (ID) Core length: 1-16" Working pressure:4000 psi Temperature: 100°C (212°F)</p>




	<p>Custom designed</p>	<p>7" (L) x 1" (ID) Core length: 4" 9" (L) x 1.5" (ID) Core length: 5"</p>	<p>Working pressure: 1000 psi Temperature: 150°C (300°F)</p>
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Floating Pistonless/Piston Accumulators


Floating Pistonless Accumulators are used as pressure surge accumulators, chemical reaction vessels and as recombination cells.

Floating Piston Accumulators are used for the displacing of fluid through core floods and similar displacement tests.

	<p>Pistonless Accumulator CXS-20-500-SS-572</p>	<p>15.5" (L) x 6.2" (ID)</p>	<p>Working pressure: 2000 psi Temperature: 300°C (572°F) Volume: 5000 cc</p>
	<p>Pistonless Accumulator CFR-20-500-SS-500</p>	<p>17.7" (L) x 5.6" (ID)</p>	<p>Working pressure: 2000 psi Temperature: 260°C (500°F) Volume: 5000 cc</p>

	<p>Pistonless Accumulator CFR-20-1000-SS-500</p> <p>31.5" (L) x 5.6" (ID)</p> <p>Working pressure: 2000 psi Temperature: 260oC (500oF) Volume: 10400 cc</p>
	<p>Pistonless Accumulator CXS-50-500-SS-572</p> <p>18.26" (L) x 6.2" (ID)</p> <p>Working pressure: 5000 psi Temperature: 300oC (572oF) Volume: 5000 cc</p>
	<p>Piston Accumulator CFR-150-050-SS</p> <p>25.4" (L) x 1.5" (ID)</p> <p>Working pressure: 15000 psi Temperature: 177oC (350oF) Volume: 500 cc</p>

Soxhlet Extractors and Dean-Stark Apparatus

	<p>The soxhlet extractors are used for the extraction of oils from oil saturated cores or for cleaning heavy oil-saturated cores with various solvents.</p> <p>With different sizes of soxhlet extractors, EOGRRC group is capable of processing cores with different sizes (from 1" to 4" in diameter) or different degrees of cleanness.</p>
	<p>Capability:</p> <ul style="list-style-type: none"> • 4 sets small size of soxhlet extractor, with 250 ml flask • 1 set medium size of soxhlet extractor, with 500 ml flask



- 2 sets large size of soxhlet extractor, with 1000 ml flask
- 1 set extra-large size of soxhlet extractor, with 4000 ml flask
- 1 set Dean-Stark apparatus with 2000 ml flask

3. Test/Measurement Systems and Setups

Core Flooding System



The Core Flooding System is configured for the measurement of permeability and capillary pressure, and for liquid/liquid gas/liquid displacements under the conditions of overburden pressures up to 1,000 psi and temperatures up to 150 °C (300 °F) with Viton sleeves. Automated data acquisition and logging of pressures is controlled by the Labview software. Constant temperature is provided by a convection oven. A high pressure ISCO pump delivers the displacement fluid at various flow rates.

HP-HT CO₂ Injection Test System



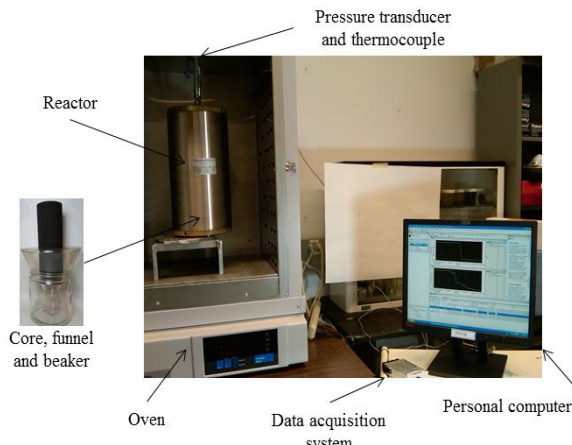
The High Pressure High Temperature Test System is used for CO₂/miscible gas injection under up to 4,000 psi and 232 °C (450 °F). It consists of high pressure vessels connected to pumps and cylinders and can be used for static or dynamic high pressure solvent injection tests. A DAQ system makes it possible to read temperature and pressure values.

Steam Injection Test System




This system is designed for high temperature steam experiments. The setup consists of a steam generation unit and a high pressure vessel that contains the main sample under test. A DAQ system is also attached to monitor pressure and temperature.

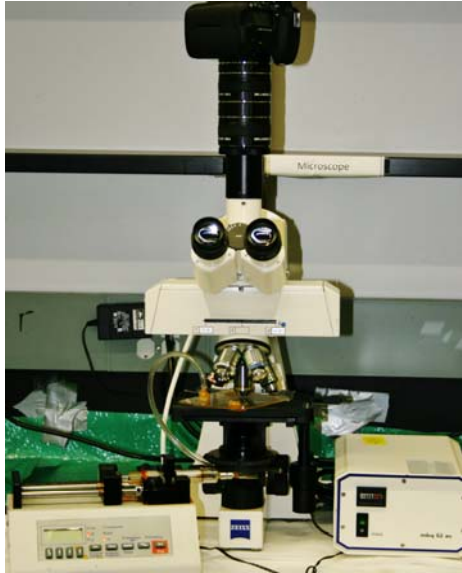
Oxidation/Diffusion Test System

 <p>The photograph shows a laboratory setup for an oxidation/diffusion test. A stainless steel reactor is mounted on an oven. A pressure transducer and thermocouple are attached to the reactor. A core, funnel, and beaker are used for introducing the oil-saturated core. The reactor is connected to a data acquisition system, which is linked to a personal computer for data recording and analysis.</p>	<p>This system consists of a stainless steel reactor in which an oil-saturated core is introduced and soaked in a gas atmosphere (solvents and air). The system is kept at static conditions and pressure and temperature are measured with time. The reactor is connected to a data acquisition system for data recording. Gas pressure data is analyzed as well as fluid composition to assess the effect of gas mixture in oil recovery by means of a diffusion and gravity drainage mechanisms.</p> <p>Working pressure and temperature of reactor are 2000 psi and 300 °C (572 °F).</p>
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HP-HT Pendant Drop Interfacial Tension (IFT) System

 <p>The photograph shows a complex laboratory setup for measuring interfacial tension at high pressure and temperature. The system includes a heating system, metering pumps, and a microscope system with a video camera for image viewing, recording, and analysis. The setup is mounted on a vibration-free table.</p>	<p>The Pendant Drop Interfacial Tension System is used for measuring interfacial tension at reservoir pressure and temperature, up to 10,000 psi and 177°C (350 °F). The cell has interchangeable needle tips to achieve a wide measurement range. The lower limit is 10⁻³ dynes/cm.</p> <p>The system sits on a vibration-free table. It includes the heating system, metering pumps, and a microscope system with video camera for image viewing, recording, and analysis.</p>
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Micro-model Visualization Setup



This setup is used to study the interactions of different phases during enhance oil recovery techniques such as solvent injection or alternative solvent and water injection. In such EOR techniques, several phases exist including matrix grain, solvent, oil and water. Therefore the visualization process requires use of UV light with application of appropriate (water-base or oil-base) tracers. With this method, it is possible to visualize more than three phases in the model.

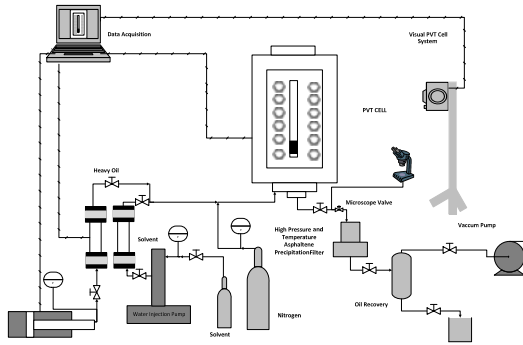
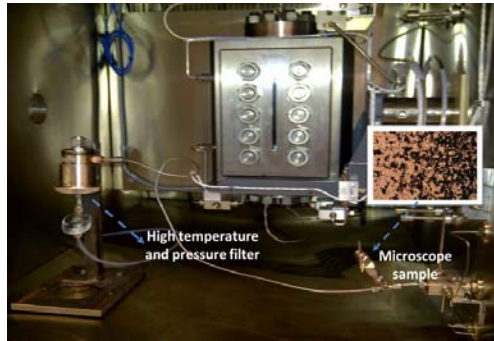
The micro-model visualization system is composed of a high speed camera mounted on a microscope, a UV light source, syringe pump and the micro-model. The maximum magnification of this system is 2600X. Therefore, with this setup it is possible to visually observe any microscopic change in the residual oil.

HP-HT Mini Bench Top Reactor



This system is used to study the chemical reactions during thermal EOR processes. It is composed of a reaction chamber and the temperature controller. The reaction chamber (600 cc volume) has three valves at the cap that enable taking gas/liquid samples and injection during the process. The maximum operation condition for this system is 350 °C (662 °F) and 2000 psi. The System is equipped with a water circulation line that is used to control the temperature. A programmed heating/cooling of the reactor is possible with the temperature controller.

PVT System



PVT Cell is precision manufactured laboratory equipment designed specifically for the measurement of fluid properties and the study of fluid phase behavior. The instrument provides a means of accurately measured and sample fluid phases at controlled temperature and pressures. Measurements of interest include various vapour/liquid physical properties such as density, vapour/liquid ratios, and independent phase compositions.

In addition, the PVT Cell has a glass tube that is connected with CCD level measurement system Long Focus and AverMedia DVD EXMaker 7 to capture the fluid visualization. Other applications such as deasphalting process have been carried out using the PVT cell. Moreover, the machine has connection to a high pressure and high temperature filter to do the asphaltenic components separation.

SARA Analysis Setup



The saturates, asphaltenes, resins and aromatics (SARA) from the medium oil, heavy oil and bitumen samples can be analyzed by our research group following the ASTM 2007 D and ASTM D2549.

To carry out the SARA test, the following instruments are used: muffle furnace, soxhlet extractor, chromatography columns, desiccator, rotary-evaporator, filtration system, and vacuum pump.

4. Computational/Simulation Lab

Station for 3D Visualization System



This station combines a 3D TV and a tracking system to build an interactive immersive user interface at relatively low cost. It can be used to visualize computer simulation results and laboratory observations.