Oil & Natural Gas Technology

DOE Award No.: DE-FE0009927

Quarterly Research Performance Progress Report (July - September 2014)

Verification of capillary pressure functions and relative permeability equations for gas production

Submitted by:
Jaewon Jang

Jaewon Jang

Wayne State University
DUNS #: 001962224
5050 Anthony Wayne Dr.
Detroit, MI 48202
e-mail: jaewon.jang@wayne.edu
Phone number: (313) 577-3854

Prepared for:
United States Department of Energy
National Energy Technology Laboratory

November 13, 2014

Office of Fossil Energy

SUMMARY

Task 1.0 Project Management and Planning
Done

Task 2.0 Pore Network Generation
Done

Task 3.0 Algorithm for conductivity and hydrate dissociation
Done

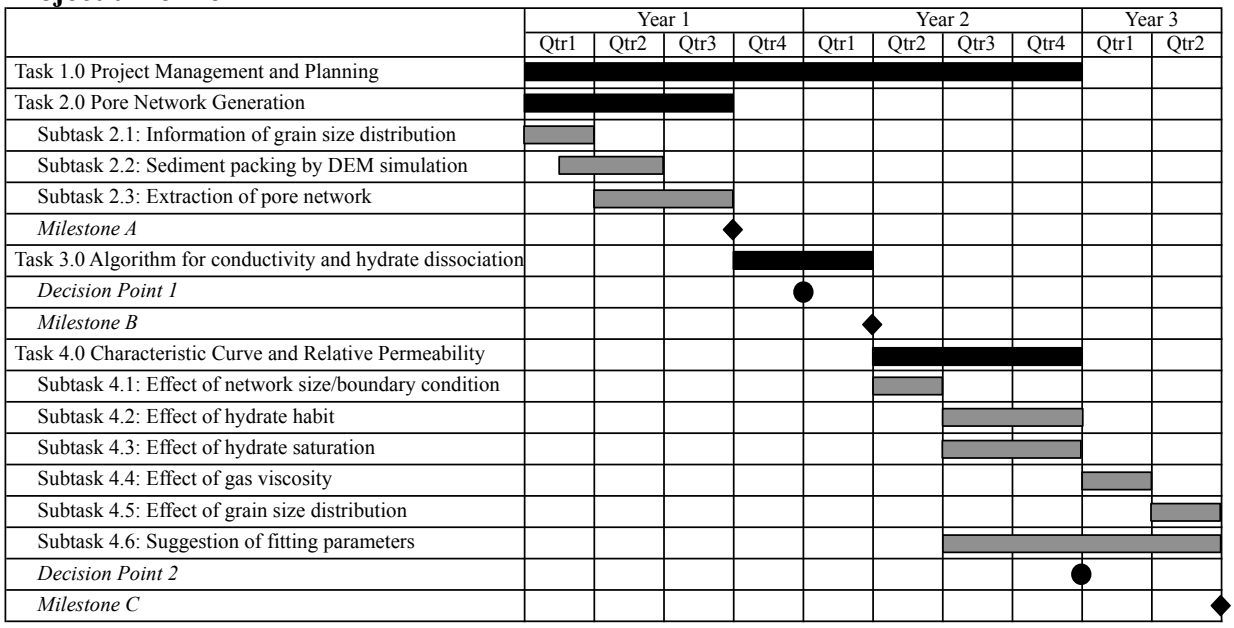
Task 4.0 Characteristic Curve and Relative Permeability
In progress

Subtask 4.1 Effect of network size/boundary condition
Done

Subtask 4.2 Effect of hydrate habit
In progress

Subtask 4.3 Effect of hydrate saturation
In progress

Project timeline



Current status of novation request

The PI (Dr. Jaewon Jang) has moved from Wayne State University to Arizona State University. The last day of working at Wayne State University is August 15th, 2014 and the start day of working at Arizona State University is August 16th, 2014.

The new contact information is shown below.

Address) 660 S. College Avenue, Tempe, AZ 85281
Office) 480-727-4309
Email) jjang19@asu.edu

During this quarter, the PI worked on the novation request. The novation request was sent to the Department of Energy on November 10th, 2014.

Summary of work during this quarter – Pore network extraction from sandy soil

During this quarter, in addition to planed tasks, the pore network model has been extracted from the X-ray image of real soil sediment recovered from Mallik 5L-38 well at the depth 1091.22-1091.49m. The soil sample was extruded from core right before it was sent to Wayne State University from USGS. The sediment in as-received condition is shown in Figure 1-(a). The grain size distribution curve is shown in Figure 1-(b). The fine content (particle size smaller than 75μm) is 6.2%. The coefficient of uniformity is $Cu=D_{60}/D_{10}=0.33mm/0.12mm=2.6$, and the coefficient of curvature is $Cc=D_{30}^2/(D_{10}D_{60})=0.22mm^2/(0.12mm\times0.33mm)=1.2$.

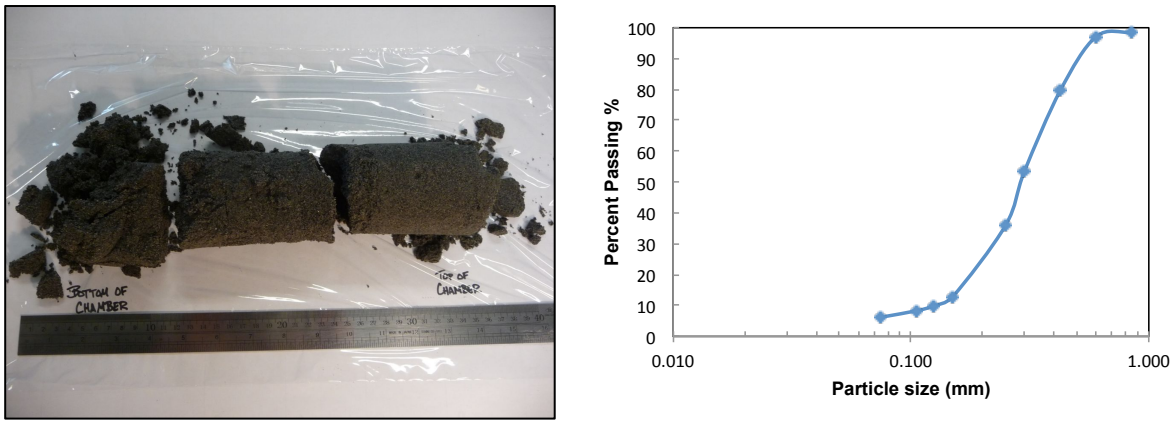


Figure 1. The information of specimen recovered from Mallik 5L-38. (a) Picture right after it is extruded from pressure core. (b) Grain size distribution of the extruded soil specimen.

The X-ray image of sand packing under 10MPa confining stress is obtained from the collaboration with DOE/NETL. A cross-sectional image is shown in Figure 2-(a). From the three-dimensional pore space, the pore network model is extracted as shown in Figure 2-(b). The size of the extracted pore-network model is 3mm×3mm×3mm. It consists of 5376 pores and 18770 tubes. The pore size distribution and tube size distribution are shown in Figure 3.

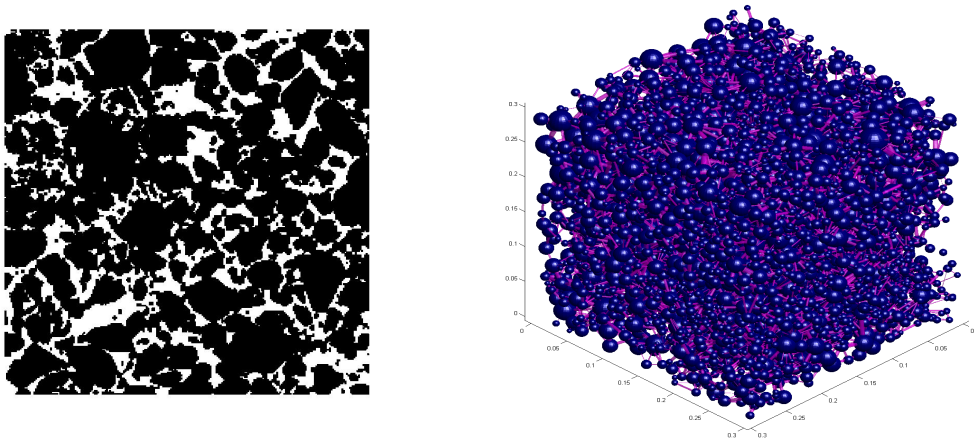


Figure 2. Pore-network model generation. (a) Cross-sectional X-ray image of particle packing obtained at DOE/NETL using sandy soil sample recovered from Mallik 5L-38. The three-dimensional size of the image is 4mm×4mm×4mm. (b) Extracted pore network model.

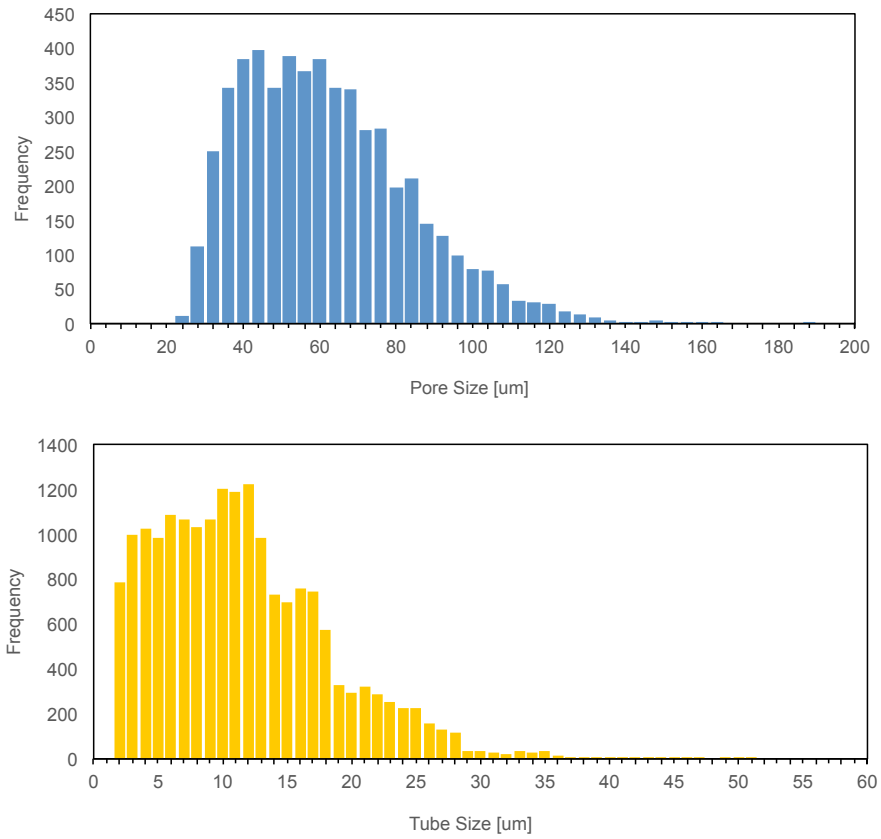


Figure 3. Size distribution of pores and tubes of the pore network model extracted from the X-ray image of Mallik sediment.

Planned work during next quarter

Using the pore-network model extracted from really sandy sediment under 10MPa confining stress, the effect of hydrate saturation and hydrate pore habit on relative permeability curves and water retention curve will be explored. The results of the research will be presented at the meeting of American Geophysical Union (AGU Fall 2014).

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

13131 Dairy Ashford Road, Suite 225
Sugar Land, TX 77478

1450 Queen Avenue SW
Albany, OR 97321-2198

Arctic Energy Office
420 L Street, Suite 305
Anchorage, AK 99501

Visit the NETL website at:
www.netl.doe.gov

Customer Service Line:
1-800-553-7681