

Screening of solvents and polymers for phase inversion to inhibit clay swelling of mudstone

Dr Archana Patel*, Dr Lei Ge**, Dr Tom Rufford*, Dr Zhongwei Chen*
 * The University of Queensland ** University of Southern Queensland

Aim and Background

- To find an eco-friendly and cost-effective solvent and polymers for a polymer immersion process to inhibit clay swelling of a mudstone sample via a polymer coating without affecting gas permeability through the coal layer.
- The concept from the chemical process used to manufacture membranes was adopted to develop a phase inversion polymer coating which binds to clay-rich interburden but remains permeable to gas and water flow on coal layers, throughout the phase inversion process.
- Figure 1 illustrates how the phase inversion concept may be applied to mitigate fines production in a CSG well. In our concept, the phase inversion polymer synthesis approach, with a water-soluble solvent, was used to form a low-porosity dense skin layer across clay-containing interburden layers.

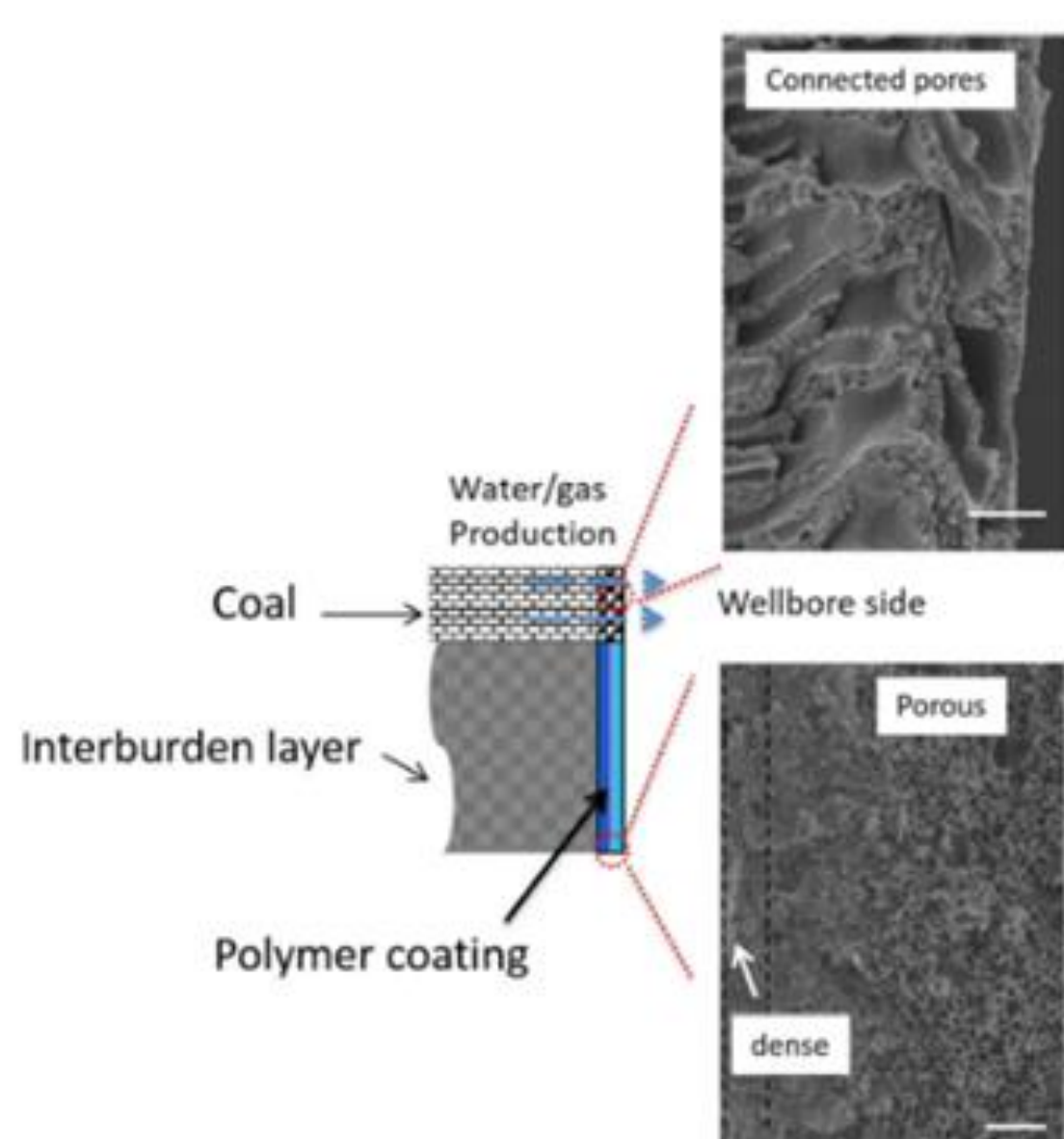


Figure 1: Schematic representation of phase inversion for polymer coating

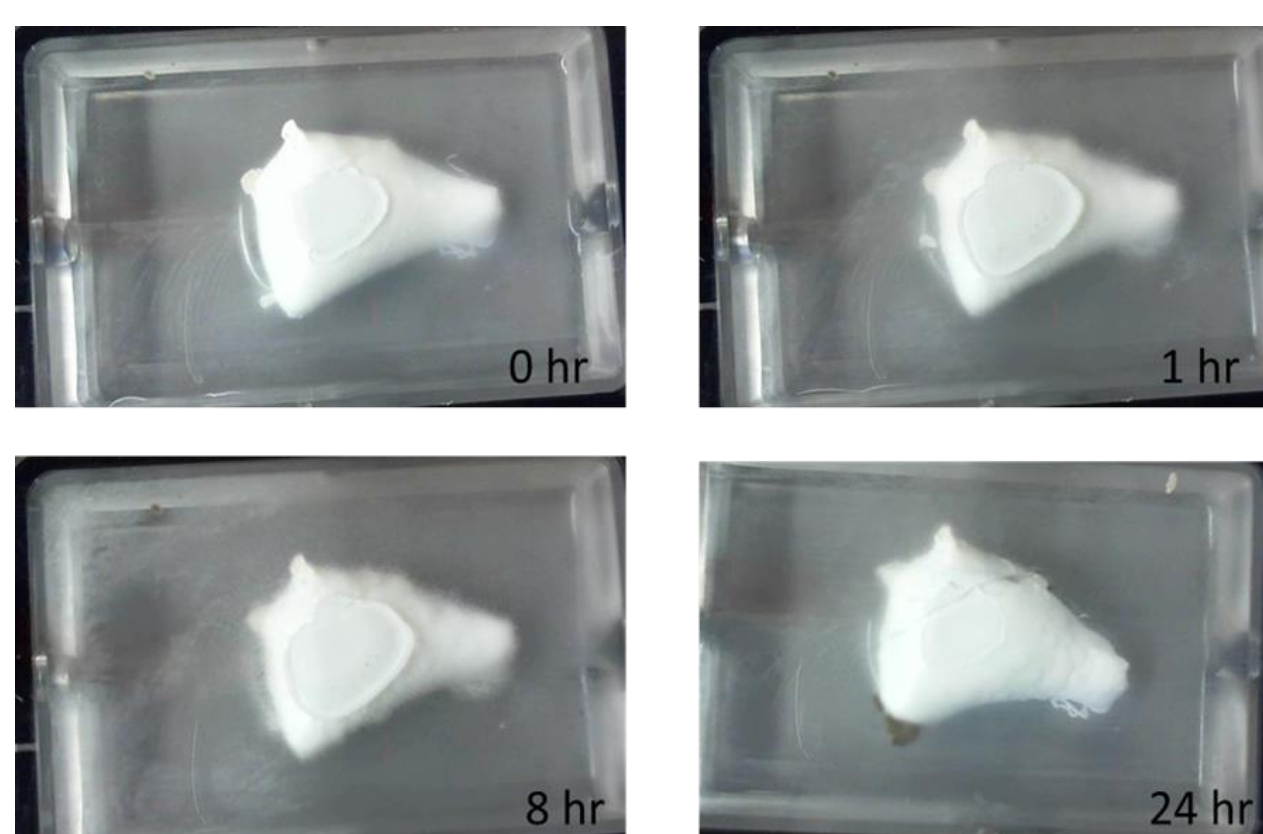
Methods and materials

Solvents: Polarclean, Dimethyl sulfur oxide, Ethyl lactate, Propylene carbonate, acetone, acetic acid.

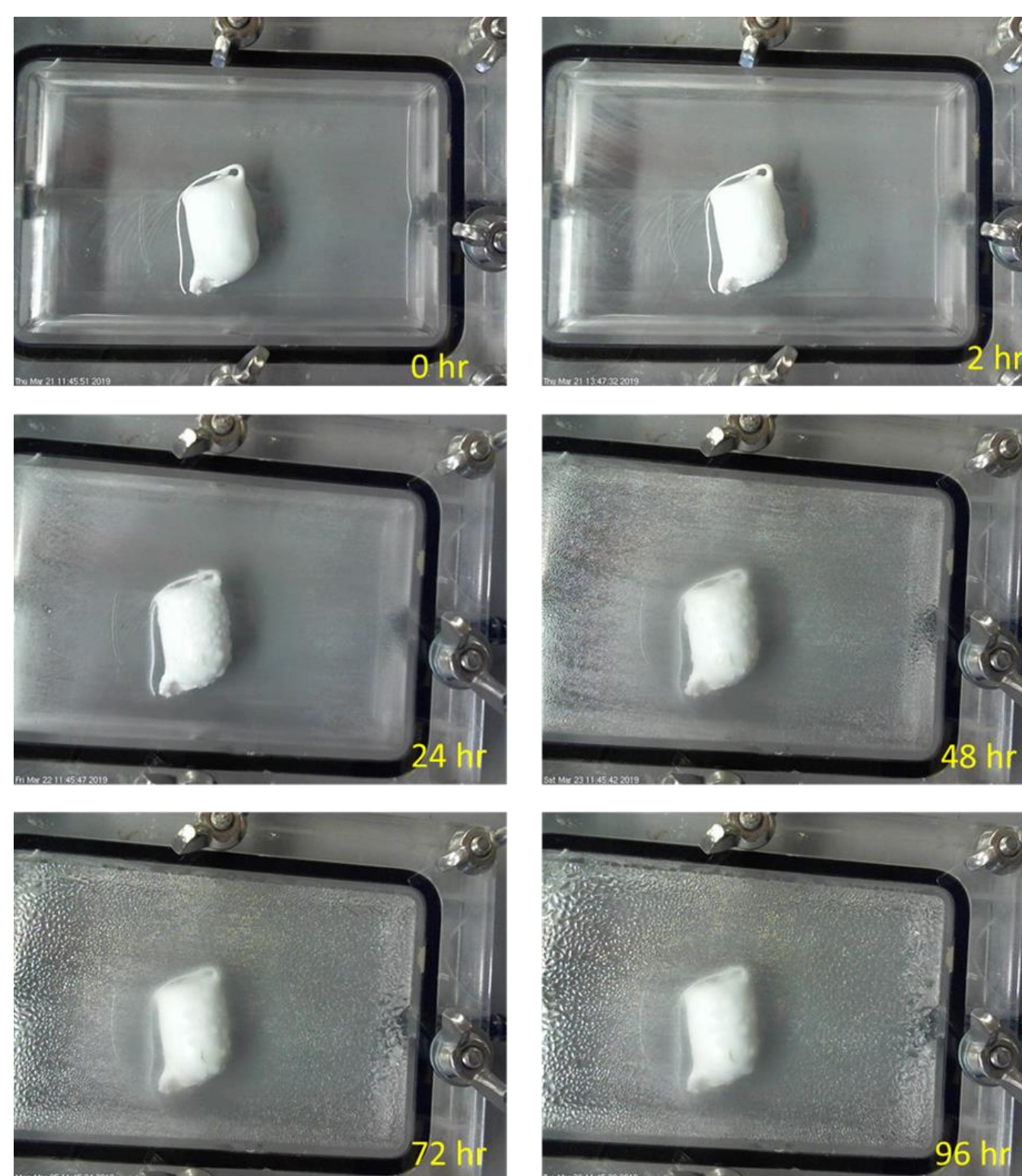
Polymers: Polyethersulfone (PES), Poly (methyl methacrylate) (PMMA), Thermoplastic polyurethane (TPU), Polyvinyl Acetate (PVA), cellulose acetate.

Polymers were dissolved in the listed solvents by using a 1:3/1:7 ratio (polymer: solvent) by weight. At this stage, the ratio of polymer to solvent is not optimised and was selected as per previous work results reported by one of the bachelor students. The ratio will be optimised when the work is focused on coal. The mixture was stirred until a complete homogeneous mixture was observed. The temperature of the mixture was increased to 50°C when required. The mudstone sample was dipped in the polymer solution for 30 seconds and straight away dipped in the water until the phase inversion process was completed and polymer film observed. The coated sample was then transferred to the flow cell and swelling of the sample was observed by capturing pictures at regular time intervals. The picture of the samples coated with different polymer solvent system are shown here.

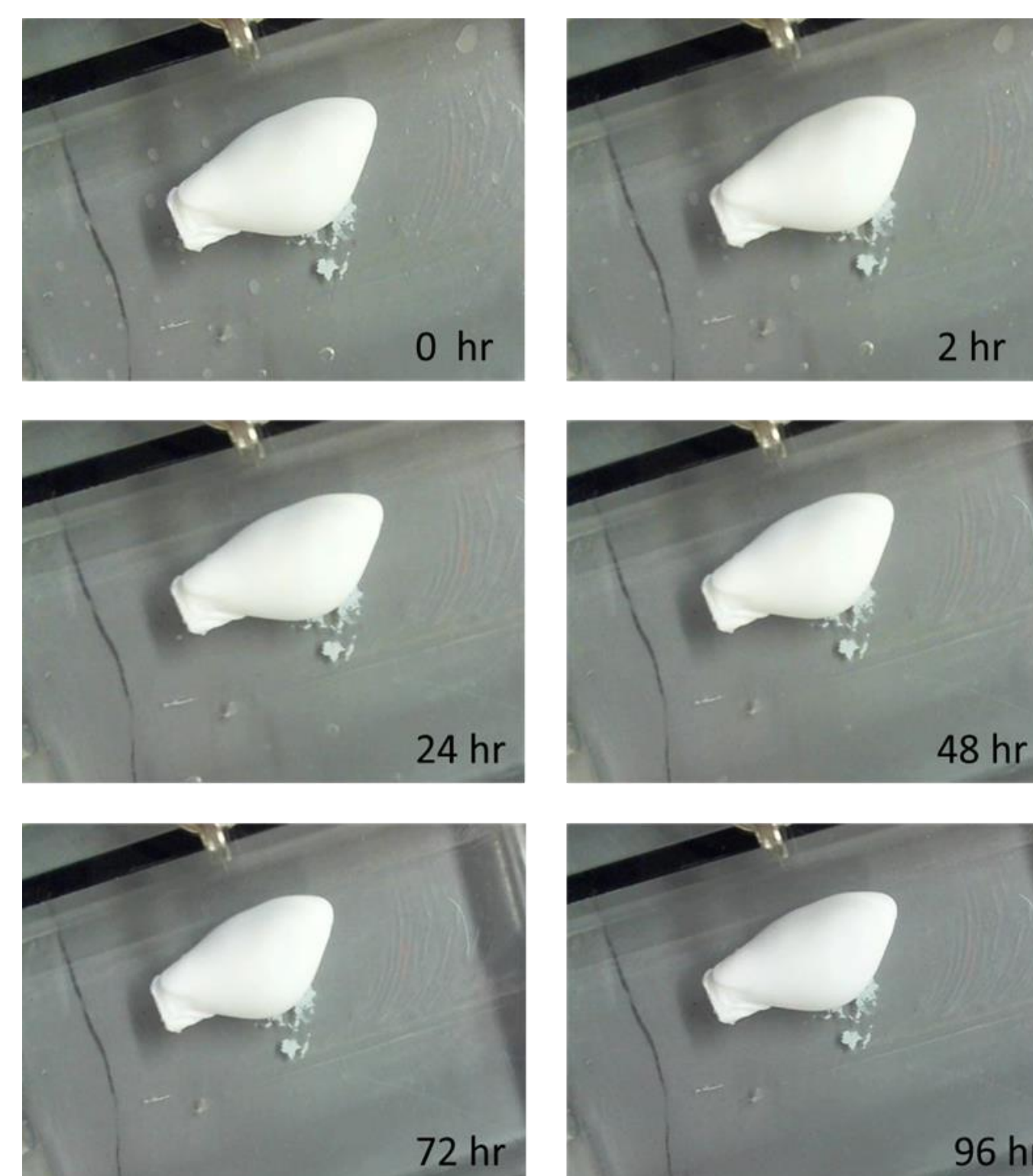
PES:DMSO



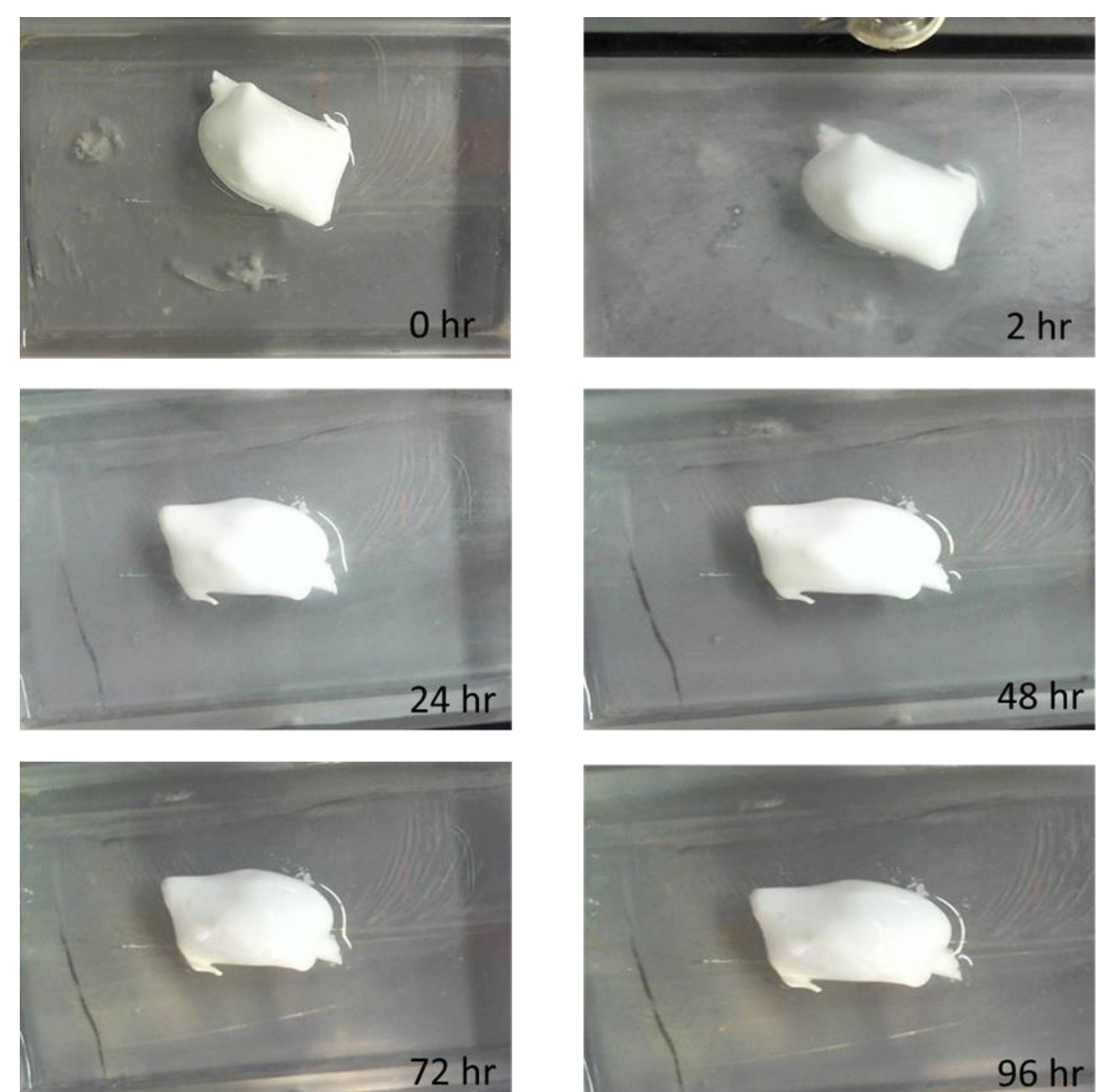
PES:Polarclean



PMMA:DMSO



PMMA:Polarclean



Acknowledgments

This research received funding through the Australian Research Council's Linkage Projects Scheme and from industry partners Santos, Arrow Energy, APLNG/Origin Energy, and also Shell/QGC through The University of Queensland Centre for Natural Gas natural-gas.centre.uq.edu.au.