

CELEBRATING
COMMERCIALISATION
YEAR 2014

iiindex 2014

AN INTERNATIONAL EXPOSITION ON RESEARCH AND INNOVATION

invention
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exposition 2014

INNOVATEUR
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2014

27th - 30th
APRIL 2014
DEWAN AGUNG TUANKU CANSELOR (DATC)
UNIVERSITI TEKNOLOGI MARA
MALAYSIA

*Bridging
the valley of death :
advancing the
commercialisation
of research*

RESEARCH BOOK

iiindex2014

AN INTERNATIONAL EXPOSITION ON RESEARCH AND INNOVATION

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FOREWORD

The Honourable Minister of Science, Technology and Innovation (MOSTI) has launched 2014 as Malaysia Commercialisation Year 2014 (MCY2014) with the theme Science Technology and Innovation (STI) for Wealth Creation. In line with this theme, Invention, Innovation, Design & Exposition 2014 (iidex2014) is an annual exposition organized by UiTM and is the ultimate platform to highlight and commercialise new inventions and innovations. Researchers and inventors will exhibit their products which cater to the needs and wants of the community and the country.

The iidex2014 creates a new dimension by fusing two competitive concepts, a competition among innovative products and a competition to invite Innovateur Wannabes to perform live pitching of their products to the audience. The iidex2014 focuses on comprehensive commercialization and creating opportunities for entrepreneurs to carry out R&D as well as to provide avenue to commercialise their products. Through expositions such as iidex2014, MOSTI hopes to inculcate the culture of commercialisation of new technology designed and created by Malaysians.

I wish to congratulate all the participants of the iidex2014 and this is the opportunity for all researchers to show their ideas and exhibits their products and creativity. Apart from showcasing their products, innovators will have the opportunity to provide a window to the industry for business matching during the exposition.

Tan Sri Dato' Sri Sallehuddin Mohamed
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NANOPARTICLE TECHNOLOGY IN AQUEOUS CARBON DIOXIDE (CO₂) FOAM FOR ENHANCED OIL RECOVERY (EOR)

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Foam Flooding is an established Enhanced Oil Recovery (EOR) approach to recover the remaining oil in the reservoir, which is implemented after primary and secondary recovery. However, foam flooding faces various problems due to low viscosity effect, which reduces its efficiency in recovering oil. The biggest challenge is to produce longer lasting foam while injecting to the reservoir for oil displacement. Foam stability can be uttered in foamability measurement and bubble size dispersal. The higher the foamability, the more stable it is. Using surfactant to stabilize CO₂ foam may reduce mobility and improve areal and vertical sweep efficiency, but the potential weaknesses are such that high surfactant retention in porous media and unstable foam properties under high temperature reservoir conditions. Thus, this research aimed to investigate the stability and foamability of CO₂ foam with addition of nanoparticle, the optimum surfactant and nanoparticle concentration with highest foam stability and determine the relationship between the foamability and the nanoparticle concentration within the carbon dioxide foam system. Foam generator has been used to generate CO₂ foam and analyse its stability and foamability under varying parameters. Surfactant solutions were prepared within 500 ppm to 5000 ppm, which was investigated at different nanoparticle concentrations from 1000 ppm to 5000 ppm. Foam stability and foamability were investigated through observation of the foam bubble size and the reduction of foam height inside the observation tube. It was found that increases of surfactant and nanoparticle concentration have boosted up the stability of the foam produced from 92% to 100% foamability and foam durability was extended up to 5 hours. The optimum concentration of both surfactant and nanoparticle was found at 5000 ppm. Liquid with the presence of both silica nanoparticle and surfactant generated more stable foam with lower mobility as the mixture reduced interfacial tension (IFT) between CO₂ and water; also strengthen the adhesive and cohesive force inside the lamella of the foam. Addition of nanosilica particle to the foam system has improved the rigidity of the lamellae interface and prevents it from rupture. Relationship between foamability and nanoparticle concentration has been determined in forecasting the foam stability, mobility and morphology with the newly breakthrough nanoparticle technology. In conclusion, novel stabilized aqueous CO₂ foam with addition of nanoparticle can be potential candidate for foam flooding application and commercialization. The relationship could provide a cost effective planning for foam flooding with addition of nanoparticle in combination of surfactant. This potential EOR research is closely related to one of the National Key Economic Areas (NKEAs), Oil, Gas and Energy, which has been attractive business contributing to socio-economy to the country such as reducing dependence on foreign oil, supporting job creation, increasing tax revenue and economic growth. Moreover, the recent 30-year deal between Petronas and Shell Malaysia for the implementation of the world's largest EOR projects in Malaysia proved that Malaysia is getting towards commercializing EOR projects. Thus, the application of nanoparticle technology in foam flooding to produce longer lasting foam with high stability and foamability is believed to offer good future in EOR projects aligned with the industrial technology development to be commercialized.