



# Laboratory validation and field assessment of petroleum laboratory technicians' dermal exposure to crude oil using a wipe sampling method

**Galea KS<sup>1</sup>**, Mueller W<sup>1</sup>, Arfaj AM<sup>2</sup>, Llamas JL<sup>2</sup>, Buick J<sup>1</sup>, Todd D<sup>1</sup>, McGonagle C<sup>1</sup>

1. IOM, Research Avenue North, Edinburgh, UK.

2. Saudi Aramco, 9F Al-Midra Towers WC-939B, Dhahran KSA 31311, Saudi Arabia

# Background

- Exposure to crude oil may increase risk of skin diseases
- Little is known about the extent of dermal exposure of workers in oil industry
- Galea et al (2014) reported wipe method for assessing exposure to oil-based fluids & crude oil
- Concluded further validation and field assessment needed to confirm suitability



# Aims

- **Lab. validation study**
  - Recovery, sampling efficiencies
  - Sample stability
- **Field sampling campaign**
  - Petroleum lab technicians
  - Standard wipe technique (pre- and post- activity)



# Validation methodology

- **Sampling efficiency**
  - Trotters spiked with known masses of crude oil
  - Trotters wiped - 10, 120 & 240 mins)
  - Trials at typical lab temp. and RH and also at 45°C and 60-80% RH
- **Recovery efficiency**
  - Known masses of crude oil spiked directly onto wipes
- **Sample storage**
  - Known masses of crude oil spiked onto wipes
  - Wipes stored in sealed glass jars for 7, 14 and 28 days



# Validation results (%)



Results are based on n-Nonadecane quantification.

Table 1: Recovery efficiency (Day 0) and storage stabilities

Day	Mean	SD	Min	Max
0	97.3	5.4	91.1	105.9
7	93.4	17.3	59.1**	106.1
14	103.3	5.4	96.0	111.1
28	94.6	2.9	91.1	99.3
54*	98.3	7.6	91.1	106.2

Table 2: Sampling efficiency of removing crude oil from pigs

Environmental conditions	10-15 min				2 hours				4 hours			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Ambient*	98.2	11.3	84.0	113.1	93.5	7.6	84.7	105	93.8	10.7	80.3	109.3
Elevated*	104.8	2.5	101.2	108.6	97.6	8.8	88.2	110.2	87.9	5.9	81.6	96.6
Overall	101.5	8.5	84.0	113.1	95.6	8.1	84.7	110.2	90.9	8.8	80.3	109.3

# Sampling campaign methodology

- Measurements collected from petroleum lab workers
- OH trained on sampling technique prior to measurement campaign
- Standardised wipe technique (pre-post activity)
- Contextual info. recorded using standardised protocol



# Post activity wipe results ( $\mu\text{g}\cdot\text{cm}^{-2}$ )



- 19 lab technicians participated, providing 35 post-activity paired samples

Wipe	%	$\mu\text{g cm}^{-2}$						
		<LOD	Min	Max	95 %ile	GM	GSD	AM
Left hand	51.4	0.88	23.1	17.5	1.54	2.3	2.63	4.6
Right hand	54.3	0.88	17.3	12.3	1.49	2.2	2.39	3.6
Paired	45.7	1.76	35.4	34.8	3.09	2.2	5.02	8.0

	Frequency of exposure (%)				Intensity of exposure (%)		
	Unlikely	Occasionally	Repeatedly	Almost constantly	Small amount	Medium amount	Large amount
Emission	66	26	6	3	91	9	0
Deposition	74	20	6	0	94	6	0
Surface transfer	83	9	6	3	91	9	0

# Discussion

- Acceptable storage efficiencies up to 54 days - if beyond this further tests necessary
- Sampling efficiencies satisfactory - indication of declines with time
  - Does not cover all conditions but shows method satisfactory under more extreme conditions
- Galea *et al.* (2014) and current study used different markers to quantify exposure
  - Selection based on bulk crude oil chromatograms
  - Need to ensure identify most appropriate marker



# Discussion

- Disposable nitrile gloves worn, disposed after use
- > 50% post-activity hand wipe results > LOD
- Spills observed and technicians did not always replace gloves until analysis completed
- Both hands contaminated through direct contact with crude oil
- Changing nature of tasks to reduce exposure via route could lead to exposure reduction



# Discussion

- Suggests method satisfactory in quantifying lab workers dermal exposure to crude oil
- Beneficial to trial approach for other oil workers (possibly higher levels of exposure)
- Data collection can allow for identification of exposure scenarios where dermal exposure to crude oil is of concern and assist in evaluation of risk management measures



- Funded by Saudi Aramco (No. 6600035583)



- Special thanks to our study participants
- Drs. John Cherrie, Anne Sleuwenhoek (IOM)
- Environmental chamber - Selex ES Ltd, Edinburgh



*X2018, Manchester, 24-26 Sept .2018.*