Oil Spill Waste Assessment Tool (OSWAT)

Philippe de Susanne,
Environmental Response Lead Advisor
Upstream HSE
BP
Oil spill waste management plan

• Development of waste management Plan for oil spill preparedness and response efforts in various Upstream Region

• Key steps :
  − Identification of waste streams
  − Quantitative assessment of waste volumes
  − Understanding waste temporary storage potential location
  − Understanding waste treatment options
Why performing waste assessment?

- The volume of waste generated during an oil spill response operation is not directly correlated to the initial quantity of spilled oil.

Figure 1 Waste generated during historical oil spill incidents (in thousand tonnes) (IPIECA, 2004)
Factor influencing the waste volumes

- Quantity of oil reaching the shoreline
- Type of oil and weathering status
- Types of shoreline substrate
- Shoreline clean-up techniques
- Clean-up treatment end points
The Oil Spill Waste Assessment Tool

• Oil Spill Waste Assessment Tool (OSWAT) is an integrated tool enabling consistent assessment of waste volumes

• Using a web-based Geographical Information Systems (GIS) interface the OSWAT integrates three existing tools:
  − the Arctic Council Waste Management Tool (PAS/TOSTC.2009),
  − the SINTEF OSCAR oil spill trajectory modelling (Reed, M, 2012),
  − the NOAA Environmental Sensitivity Index (ESI) (NOAA, 2002) GIS.
Web based tool leveraging sub-surface IT infrastructure

Integrated in the COP
ArcGIS Server 10.2.2
Oracle 11G
API code on ArcGIS server
ESI data published as webmap service
Shoreline oiling: (kg/m²) converted into (m³/m)
Oil type: viscosity
Select an area of interest
Select a response technique

Waste Quantity Calculator

<table>
<thead>
<tr>
<th>ESI Type</th>
<th>Substrate Type</th>
<th>Oil Type</th>
<th>Shoreline Oiling</th>
<th>Response Technique</th>
<th>Treatment End Point</th>
<th>Volume of Waste (kg) for Length (m) of Shoreline</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESI 1</td>
<td>Bedrock, sold</td>
<td>Heavy</td>
<td>Heavy</td>
<td>HP, Washing/flushing</td>
<td>Bulk Removal</td>
<td>0.20</td>
</tr>
<tr>
<td>ESI 2</td>
<td>Bedrock, sold</td>
<td>Heavy</td>
<td>Heavy</td>
<td>HP, Washing/flushing</td>
<td>Bulk Removal</td>
<td>0.27</td>
</tr>
<tr>
<td>ESI 2</td>
<td>Bedrock, sold</td>
<td>Heavy</td>
<td>Moderate</td>
<td>HP, Washing/flushing</td>
<td>Bulk Removal</td>
<td>0.25</td>
</tr>
<tr>
<td>ESI 1</td>
<td>Bedrock, sold</td>
<td>Heavy</td>
<td>Light</td>
<td>HP, Washing/flushing</td>
<td>Bulk Removal</td>
<td>0.24</td>
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<tr>
<td>ESI 1</td>
<td>Bedrock, sold</td>
<td>Heavy</td>
<td>Very Light</td>
<td>HP, Washing/flushing</td>
<td>Bulk Removal</td>
<td>0.24</td>
</tr>
<tr>
<td>ESI 10</td>
<td>Wetland - vegetation</td>
<td>Heavy</td>
<td>Very Light</td>
<td>In-situ burning</td>
<td>Bulk Removal</td>
<td>0.0010</td>
</tr>
<tr>
<td>ESI 4</td>
<td>Coastal Sediment Beach</td>
<td>Heavy</td>
<td>Very Light</td>
<td>Bioremediation</td>
<td>Bulk Removal</td>
<td>0.0010</td>
</tr>
</tbody>
</table>

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Validation exercise

- DST Coastal JIP with SINTEF to improve shoreline oiling prediction
- OSCAR validation on Amoco Cadiz
- Le CEDRE Shoreline categories for French government
- Used as a basis for validation
Case study on Amoco Cadiz

- **Vessel:** Amoco Cadiz
- **Date:** 16th March 1978
- **Cause:** steering gear failure
- **Release:** Over a period of two weeks the entire cargo of 223,000 tonnes of light Iranian and Arabian crude oil and 4,000 tonnes of bunker fuel was released into heavy seas.
- **Waste volumes estimation:**
  - Le CEDRE: more than 100,000 tonnes of oil emulsion and other wastes
  - Polaris (2009): 8,500 tonnes liquid waste and 165,000 tonnes of solid
  - IPIECA (2004): 300,000 tonnes (220,000 solid, 80,000 liquid)
  - REMPEC (2011): 250,000 tonnes of waste in total
Observed shoreline impacted area

Amoco Cadiz Shoreline impacted area Pierre Bellier (CEDRE) and Georges Massart (CEDRE-CNEXO) (1979)
OSCAR simulation shoreline oiling output (SINTEF)
Mass balance

50,000 Tonnes day

20

75% Water Intake

4 times more volume
Figure 3 OSCAR Shoreline oiling import into the Waste Calculator Tool
Shoreline type in West of France (le CEDRE)
Environmental Sensitivity Index (ESI)

Figure 4. ESI shoreline type imported in the waste calculator tool
Selection of shoreline clean-up technique

- On rocky shore: flushing and recovery
- On coarse sediment beach: manual removal
- On wetland and vegetation: manual removal

Figure 5 Illustration of the waste calculator interface for the selection of shoreline clean-up
# Waste volume calculation

<table>
<thead>
<tr>
<th>Substrate Type</th>
<th>Shoreline Oiling</th>
<th>Response Technique</th>
<th>Volume of Waste per m of Shoreline (m³/m)</th>
<th>Sum of Shoreline Length (km)</th>
<th>Volume of Liquid Waste (m³)</th>
<th>Volume of Solid Waste (m³)</th>
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</thead>
<tbody>
<tr>
<td>Bedrock or Solid</td>
<td>Very Light</td>
<td>Flushing &amp; Recovery</td>
<td>0.048</td>
<td>331</td>
<td>15,936</td>
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<td>Light</td>
<td>Flushing &amp; Recovery</td>
<td>0.048</td>
<td>65</td>
<td>2,627</td>
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<tr>
<td></td>
<td>Moderate</td>
<td>Flushing &amp; Recovery</td>
<td>0.06</td>
<td>65</td>
<td>3,955</td>
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<td></td>
<td>Heavy</td>
<td>Flushing &amp; Recovery</td>
<td>0.084</td>
<td>454</td>
<td>38,207</td>
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<td>Coarse Sediment Beach</td>
<td>Very Light</td>
<td>Manual Removal</td>
<td>0.165</td>
<td>114</td>
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<td>Manual Removal</td>
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<td>19</td>
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<td>Heavy</td>
<td>Manual Removal</td>
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<td>175</td>
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<td>Wetland - vegetation</td>
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<td>Manual Removal</td>
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<td>40</td>
<td>19,336</td>
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<td>Light</td>
<td>Manual Removal</td>
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<td>7,229</td>
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<td>Manual Removal</td>
<td>1.08</td>
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<tr>
<td></td>
<td>Heavy</td>
<td>Manual Removal</td>
<td>1.88</td>
<td>20</td>
<td>39,172</td>
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<tr>
<td><strong>Total</strong></td>
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<td></td>
<td><strong>2,674</strong></td>
<td><strong>60,725</strong></td>
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</table>
Results and Limitations

• OSWAT Results: 286,225 tonnes total (60,725 liquid and 225,500 Solid)
• IPIECA (2004): 300,000 tonnes total (80,000 liquid and 220,000 solid)

• In real life volume of waste are largely dependant on:
  − Training and expertise of the responders
  − The clean-up technique selected

• Model limitation:
  − Trajectory modelling have a range of uncertainty
  − Waste quantity assessments taken from the Arctic Council Waste Management Tool (PAS/TOSTC 2009) is a broad range
  − The tool is dependent on shoreline length and therefore on the resolution of the shoreline
Conclusion

- The validation exercise of OSWAT on the Amoco Cadiz historical oil spill indicates that the waste volume estimations are consistent with historical events.
- The OSWAT tool was found valuable tool to produce quantitative assessment of the potential volume of waste generated as the result of shoreline clean-up operation.
- A next step in the development of this tool would be to conduct further validation testing in a different shoreline environment.
- Externalise the tool and make it available.
Reference


- CEDRE. 2011. Guidance on Waste Management During a Shoreline Pollution Incident. Operational Guidelines... (80 pages.)

- CEDRE. Extrait de l'atlas de sensibilité du plan Polmar du Finistère


