

Umbilical Blockages JIP launch meeting

The Industry Sponsor's View

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The Problem

Subsea chemical injection and hydraulic systems can become blocked or restricted

Why?



The Immediate Reasons

- Unstable fluid at operating conditions
- Mixing of incompatible fluids e.g. MeOH +...
- Backflow into cores - produced fluids
- Leaks e.g. NRVs
- Commissioning practice
- Human error e.g. fluid bunkering, diligence, ...
- Inadequate hardware design
- Modification of hardware (filter removal)
- Inadequate change-out procedure
- Residual contamination
- Inadequate maintenance e.g. chemical storage
- Contamination from common systems e.g. transfer hoses
- Etc...

- All elements of the system
- The consequence is destabilisation of fluid



High Level Reasons

Lack of ...

- Industry procedures and standards
- Holistic / systems engineering approach to subsea systems
- Understanding of the risk and consequence



The Consequences

- Gannet interventions 1998-2001: £0.75 million & deferment of 250,000 bbls
- Merlin subsea chemical injection skid recovery: DSV intervention at £300-500k – recovered twice
- Gannet R32 unblocking cost estimate - DSV winter rate £250k/d + £250k/d mobilisation (actual cost £400k) + 2500 m³ deferment.



Gannet E/F/G Fields

Field producing 3500 m³/day shut in on 12th July 2005

5 scale/corrosion inhibitor chemical cores blocked

DSV onsite 7th August 2005 for 15 days (2visits)

Unable to unblock any cores

All 5 spare cores utilised to restore production (no redundancy left)

Production restored on 24th August 2005

Deferred production = 43 days

DSV cost = £1.7 Million

Production cost = £1.0 Million (Deferred production value)



What is needed?

System engineering approach:

- Risk assessment of system / lifecycle analysis
- Understand the limitations and constraints of each part of the system: the fluid, the hardware and the operator
- Reconcile the limitations and constraints



JIP Proposal

Development of two industry recognised standards:

- **Recommended Code of Practice for the Selection, Handling, Storage and Transmission of Control and Well Service Fluids**
- **Specification to Qualify Control and Well Service Fluids for Subsea Usage and Transmission Through Small Bore Fluid Conduits**



Examples of Chemical & Hydraulic Umbilical Core Blockage



IMMEDIATE REASONS FOR BLOCKAGES

- Backflow of produced fluids into chemical cores
 - Introduces solids & incompatible fluids
 - Hydrate formation (water & oil based)
- Solvent permeation through nylon cores
 - Solvent promotes phase separation that blocks core



IMMEDIATE REASONS FOR BLOCKAGES

- Solids accumulation due to laminar flow in cores
 - Solids cannot be flushed due to system pressure limits preventing turbulent flow being established
- Unstable process chemicals precipitate solids
 - High concentration solutions that are close to stability limits
 - Complex products with trace manufacturing by-products

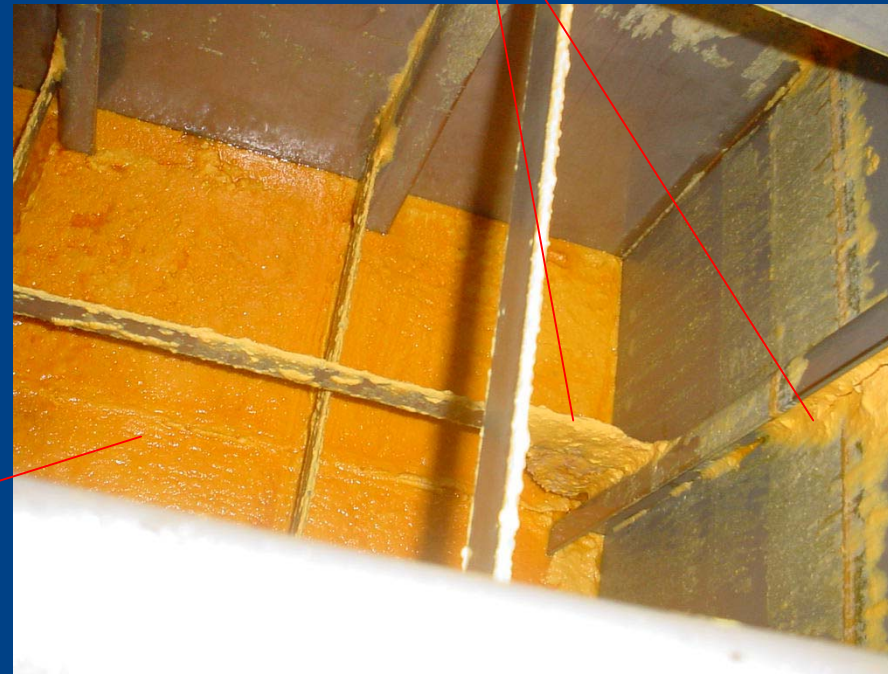


UNSTABLE PROCESS CHEMICALS

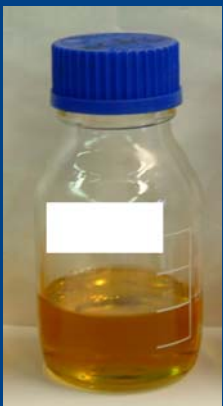
Example of solids drop-out in offshore storage



Adherent solid



Floating solid



IMMEDIATE REASONS FOR BLOCKAGES

- Incompatible process chemicals at extreme mixing range (e.g. 99:1) during change-out
 - Residual surface active chemical adheres to cores & remains in dead legs
- Human error
 - Mixing of incompatible chemicals during bunkering or system connection



IMMEDIATE REASONS FOR BLOCKAGES

- Inadequate filtration: process chemical & injection system
- Commissioning debris not removed
- System leaks e.g. sea water ingress into hydraulic system containing oil based hydraulic fluid



INCOMPATIBILITY OF CASTROL BRAYCO MICRONIC SV200 WITH SEA WATER



Dissolver specifically formulated for *in-situ* low temperature dissolution of basic magnesium carbonate solid



IMPROVED CHEMICAL SELECTION

- Code of Practice for Selection and Application of Chemicals in Subsea Systems
- Concentrate compatibility with respect to other process chemicals e.g. methanol, scale inhibitor, etc.
- Formulation e.g. addition of glycols/
minimisation of water content to prevent hydrate formation



IMPROVED CHEMICAL SELECTION

- Displacement procedure: Prefill with compatible fluid (80/20 MEG/H₂O), ensure compatibility when changing-out, consider spacer, etc.
- Filtration: reconcile hardware design with chemical solids content & size
- Stability: cold stability tests



STABILITY TEST: 3 MONTHS AT 4°C



All three products started clear

Hazy

Clear

