Gas transfer during project mobilisation

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Approximately one hour into the gas transfer operation from a quad (48 pack) of 20% oxygen / 80% helium to storage tubes via a large (D1247) Williams & James compressor an explosion occurred, causing extensive damage to the compressor and its associated high pressure pipework.

Our member's investigation revealed the following:

Analysis of both the quads and storage tubes indicated that the oxygen level was 21%. Analysis of the damaged pipe found that oil was present – the investigation did not enable any firm conclusion as to the cause of the explosion to be drawn.

The incident investigation could not reach a definitive cause of the incident but identified one or a combination of the following as possible contributing factors:

- Incorrect assembly of certain compressor components in particular the piston ring unit which could have caused oil to be dragged from the injection point up the cylinder wall into the pressurised area of the cylinder.
- Excess oil in the cylinder head would have reduced the clearance between the piston and cylinder head. This could have resulted in compression ignition of the oil, this would then have travelled along the discharge pipe from the third stage head to the cooler as the pipework would all have been coated in oil.
- From previous investigations it was noted that the compressor was 'oily' and oil had been seen in the first desiccator stage of the filter system which could indicate that the third stage was over oiling.
- The compressor safety shut down system incorporates a high gas discharge temperature switch, which did not operate in time to avoid an explosion.
- Possible incorrect or not the most satisfactory filter medium in use, allowing oil vapours/ residue to accumulate and not be satisfactorily removed.
- Carbonisation of lubricating oils on valve plates and intercoolers by high operating temperature.

Recommendations

The company involved implemented the following recommendations:

1. Review compressor maintenance routines.
2. Use Anderol 500 oil instead of the recommended Shell Corena P100.
3. Fitting of coalescer type oil separator to the discharge to remove as much oil droplet/vapour prior to entering long delivery pipeline runs and filter elements.
4. Filtration must not include activated carbon.
5. Dual use of a compressor for dual air and heliox mixes is not

recommended.

6. Compressor model D1247 is not suitable for air compression.
7. Oxygen level for compression to be limited to a maximum of 20%.