Lessons Learned Database
Individual Incident Summary Report

IChemE
Safety & Loss Prevention
Special Interest Group

Incident Title	**Nitration Plant Residue Exothermic Runaway**
Incident Type	Jet Fire
Date	21st September 1992
Country	UK (England)
Location	Castleford (W. Yorkshire)

Fatalities	**Injuries**	**Cost**
5	201	Unknown

Incident Description

Credit: UK Health & Safety Executive

Mononitrotoluene (MNT) was being manufactured by continuous reaction of toluene with a sulphuric/nitric acid mixture under controlled conditions. The nitration reaction produced 3 types (isomers) of MNT which were separated from each other by distillation and crystallisation. The residual by-product contained dinitrotoluenes (DNTs) and nitrocresols, both of which were known to be unstable and to decompose violently. The by-product was routed to intermediate storage for subsequent batchwise processing in a vacuum still to recover good quality nitrobenzene. In the period immediately before the incident, heavy heel material that had accumulated at the bottom of an intermediate (vacuum still feed) storage tank over many years was being removed to enable re-purposing of the tank. The heel material was charged to the vacuum still where it was distilled satisfactorily. However, the residue did not drain from the stillbase vessel and became more viscous and harder as it cooled. The vessel was opened for cleaning for the first time in 30 years. A decision was taken to warm the residue using the stillbase internal steam batteries. A few hours later, while the warmed residue was being manually raked out, a 60 m (197 ft) long jet fire emerged from the open manway. Five people were killed (4 in the control room, 1 in the main office block).

Incident Analysis

Basic cause was exothermic decomposition and auto-ignition of nitration residues during stillbase vessel internal cleaning activities.

Critical factors included: 1) The atmosphere and sludge in the stillbase had not been analysed, 2) The residue in the stillbase was heated and manually raked (high risk as unstable), 3) The steam pressure regulator was faulty (steam supply hotter than intended), 4) The temperature sensor was located above the sludge level (did not indicate sludge temperature), 5) The control room was located close to the plant, 6) The control room had a timber frame construction and inward opening doors (impeded escape), 7) The integrity of the office fire walls had been breached during earlier internal modifications.

Root causes included: 1) Inadequate control of work (sludge and stillbase atmosphere not sampled), 2) Inadequate management of change to organisation and plant operations (inexperienced team leaders, overworked area manager and abnormal stillbase operation), 3) Inadequate training, 4) Inappropriate plant layout (occupied buildings too close to plant).

Lessons Learned

1) People transition through organisational change cycles at different speeds and have different training and support needs, 2) Organisational change and the process of transition to the new organisation require careful assessment and should take into account human factors (e.g. workload, stress, fatigue, etc), 3) The positioning and structural design of control rooms and occupied buildings close to process plant require careful consideration, 4) Doors to occupied buildings on process plant should open outwards, 5) Muster/roll call procedures should be routinely practised.

More Information

1) “The Fire at Hickson & Welch: A report of the investigation by the Health and Safety Executive into the Fatal Fire at Hicks & Welch Ltd, Castleford”, HSE Books (1994), ISBN 0 7176 0702 X.
2) “The Fire at Hickson & Welch”, T. Kletz, IChemE Loss Prevention Bulletin 227 (October 2012).
3) “Failure to Manage Organisational Change - a Personal Perspective”, M. Lynch, IChemE Loss Prevention Bulletin 267 (June 2019).

Industry Sector	**Process Type**	**Incident Type**
Fine Chemicals	Meissner Nitration	Jet Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Not equipment-related	Not applicable	Not applicable

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