Lecture PA6

Explosion in Nitroglycerine Plant at Gullaug, Norway

M Mellbye

Explosion at Gullaug 23.01.01

Presented by
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Dyno Nobel ASA

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15.01.01 . . . . . .

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23.01.01 at 10:10 . . . . . .

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23.01.01 at 12:00. . . . . .

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Explosion in nitrating building 23.01.01 at 10:08:15 . . . . . .

- Approximately 100 kg nitroglycol reacted
- No persons were injured
- Complete destruction of building and equipment
- Large amount of nitric gases evolved
- Measured to 0,14 on Richter's scale

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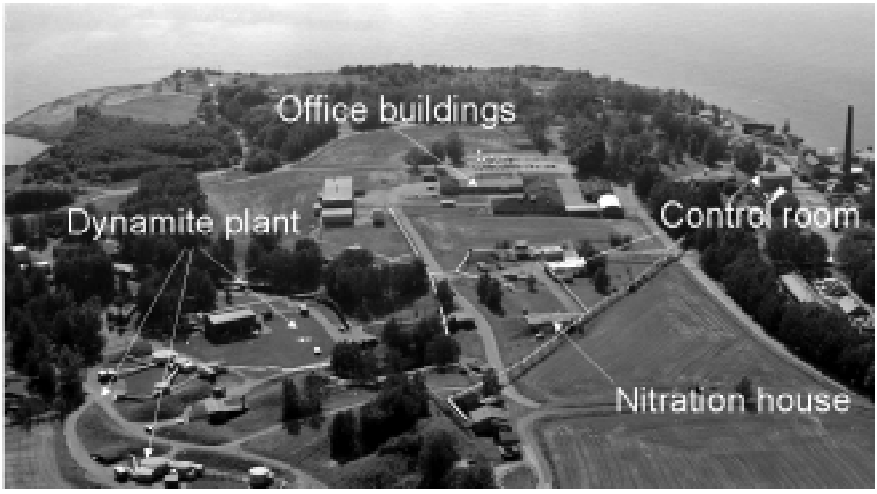
Gullaug factory



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Large damage to buildings

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Roof and floor thrown away

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All process equipment destroyed

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The investigation team

A collaboration between the police, DBE, NDRE and representatives from Dyno

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Conclusions

The most likely cause of the accident was detonation in NGK that had leaked into the cooling jacket

- This detonation lead to a chemical reaction inside the nitrator, possibly as a detonation in a smaller volume. The rest of the nitrator content deflagrated
- Debris from the nitrator initiated chemical reactions in the separator and wash water separator, where detonation took place in the continuous NGK-phase
- The content of the washing tanks may have deflagrated

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Biazzi nitrating plant

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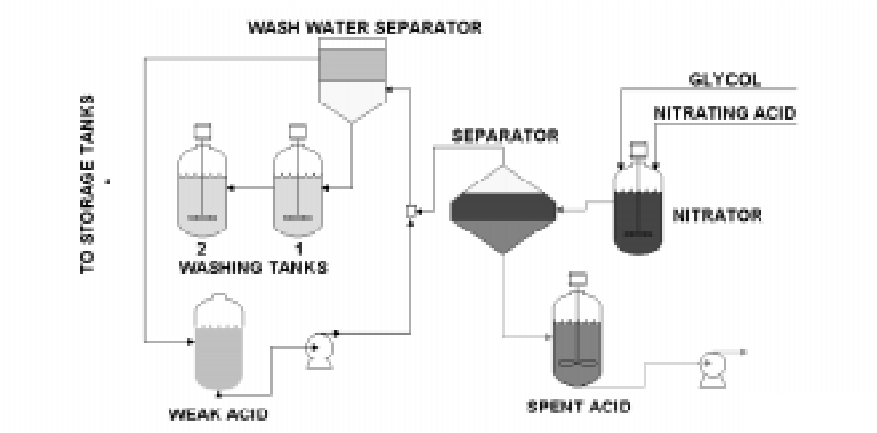
Simplified flowsheet



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Possible starting places

- Nitrator
- Separator
- Ejector
- Washing tank 1 and 2
- Wash water separator
- Weak acid tank
- Spent acid tank
- Buffertank for spent acid
- Pumps

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Possible starting places

- Pumps are not very likely because
  - they have been found relatively unbroken
- Spent acid tanks are not very likely because
  - they have been found relatively unbroken
- Weak acid tank is not very likely because
  - it was found relatively unbroken

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Possible starting place–wash water separator

- Contents continuous phase with NGK
- No stirrer
- Relatively large piece of the upper part has been found
- Has been hit by fragments from right
- Not the likely starting place

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Possible starting place–washing tank 1 and 2

- Content partly acidic NGK
- Has stirrer
- Should only content emulsion
- Hit by fragments from right
- Washer 1 was more damaged than washer 2
- Not the likely starting place

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Possible starting place–the ejector

- Sucks NGK in continuous phase
- Air bubbles may give hot spots
- Has been found relatively unbroken
- Not the likely starting place

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Possible starting place–separator

- Contents acidic NGK
- Contents large amounts spent acid
- At least 5 known world wide incidents with explosion in the separator
- Has no stirrer
- Heavy damage on the right side
- Less damage on the lower part

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Possible starting place–separator cont.

- Emergency drain valve almost undamaged
- Upper part of separator not found
- Not the likely starting place

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Possible starting place–nitrator

- Contents acidic NGK in emulsion
- Has a stirrer
- Heavy exothermic reaction
- Top of nitrator “blown” upwards onto the stirrer bracket
- Signs of detonation in the bottom of the nitrator
- Larger damage to the bottom compared to the top

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Possible cause

- Chemical unbalance
  - No irregular values for the nitration- or spent acid
  - No abnormal process values observed
  - One shaft controls both glycol and nitration acid pump
  - Flow meters controls correct flows
  - Large leakage of nitrating acid after the flow meters would lead to chemical unbalance
  - Cooling loop to slow to cool down a quick temperature rise
  - Chemical unbalance not very likely

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Possible cause cont.

- Lack of stirring
  - Lack of stirring may lead to a quick temperature rise and deflagration, possibly detonation
  - Sensor checked that the shaft was rotating
  - Investigation confirms that the impeller was in place
- Lack of stirring not very likely

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