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Discharge Damper Failure of a Triplex Plunger Pump - Root cause analysis, solutions and future prevention

Author:

Bas Tilborghs
Production Support Coordinator
Yara Sluiskil b.v.
NL-4540 AA Sluiskil, The Netherlands

Co-Author:

Harry Korst
Pulsim Project Manager
TNO Science & Industry
NL-2600 AD Delft, The Netherlands



Summary

A new triplex pump was installed in parallel with four existing plunger pumps to service a high-pressure carbamate duty. Despite of the design efforts, a short time after start-up a crack occurred in the 25 mm-thick duplex shell of the discharge damper of the new pump. Harmful carbamate was released through the crack. In order to get the pump back into operation quickly, a new damper was constructed with an increased wall thickness of 30 mm. After one month of operation also this second damper failed.

A root cause analysis was started with extensive simulations of pulsation levels in the entire discharge system. During these simulations the focus was put on pulsation levels inside the discharge damper (a location that is not addressed in API-Standard 674). To verify the simulated extremely high amplitudes inside the damper, field measurements were executed to quantify pulsation and strain levels for a wide range of operating conditions. These measurements indeed showed high pulsation levels in the discharge damper. On top of this a strong dependency on pump speeds and the presence of leaking discharge and suction valves was demonstrated. The solution to the problem was omitting most critical conditions from the operating envelope and installing a smaller, more robust damper including restriction orifice. This solution has been successfully implemented without any loss of production.

A small inventory showed that in the recent past, at least one similar problem has occurred in another installation. To avoid future occurrences in other installations this paper provides an improved approach for the design phase of new pumps and installations. The paper concludes with a proposal to extend the API-Standard 674 with an additional pulsation criterion, which should prevent any future occurrence of this particular problem.