



Technical Paper

Oil, gas and refinery applications

Session 1-3

Latest development on barrel multistage pumps for refinery application

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Summary

In the last years, significant changes of the operating conditions have been noticed for the multistage barrel pumps (type BB5 as defined in ISO13709) used in the refinery application. The required Total Delivery Head has increased above 2000 m also combined to high operating temperatures (larger than 260 °C).

The dynamic behaviour becomes a real challenge for pump manufacturers as the demand for pumping solutions for very light density fluids increases (propylene, butane and propane in HPI¹ processes for example). A multistage pump with a high stage number and pumping a very light fluid has low resonance frequencies and damping levels; the rotor can be unstable when negative damping levels are encountered. Very often an increase of shaft diameter or change of pumped fluid density are not possible. Therefore rotor design and bearing arrangement have been reviewed to improve the rotordynamic behaviours of centrifugal pumps.

This article describes how the design of an API BB5 pump is chosen regarding rotordynamic criteria. Modern multistage centrifugal pumps designed for HPI processes have to reach very high pressures (up to 400 bars) by using up to 16 stages. The length of these rotors reaches more 2,5 meters combined with large distance between bearings.

A significant design improvement "Back to Back configuration" has been introduced in the multistage pump which reduces bearing spans and adds damping at the centre of the shaft in the centre bush. Modern calculation methods and tools can take into account the influence of the interaction between fluid and structure in the rotordynamic behaviour of the rotor and pushes further the limits of centrifugal pumps which fulfil the ISO13709 criteria. A complete range of barrel type pumps has been designed applying dynamic criteria and diagrams were created in order to select properly the adequate pump design and options such as swirl brakes.

¹ HPI: Hydrocarbon Processing Industry