

Experimental and FEM Vibration Analysis of Impellers used for Water Pump

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ABSTRACT

The impeller is an essential component of the water pump. Vibrations of the impeller have a significant effect on the pump's performance, as well as posing some damaging effects. In this study, the vibration of three different types of impellers for water pumps (brass, bronze, and plastic) was evaluated experimentally and compared with computational finite element method (FEM). A number of variables includes temperature, flow rate, impeller material composition, and the chemical composition of water been studied. The findings indicated that vibration issues increased as flow rate increased. The plastic impeller has the highest vibration rate compared to brass and bronze impellers under the identical testing conditions. The vibration rate of impellers tested in seawater is higher than that them tested in tap water. Increasing the temperature of the water accelerates the vibration process. Cavitation occurs in seawater at a lesser Net Positive Suction Head (NPSH) than in tap water.

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1. INTRODUCTION

Pumps are devices that move fluids mechanically usually by converting electrical energy into hydraulic energy [1]. An impeller is a component of a pump that rotates at high speeds and act as propellers to raise the pressure and flow of fluids [2]. Impellers are made of various types of materials, the most popular of which are brass, bronze and plastic. Brass is a metal alloy consisting primarily of copper and zinc, while bronze is a metal alloy composed primarily of copper with tin as the main additive, but also containing manganese, arsenic, iron, and silicon [3]. Plastic impellers are less costly, offer a wide range of chemical resistance and lighter in comparison to metal impeller types.

There is a widespread use of pumps in Iraqi cities for lifting water from reservoirs to storage tanks. Among the most serious problems associated with water pumps is impeller vibration which reduces pump life, pumping power, and affecting the pump's stability [4]. A variety of factors affect impeller vibration, including bent shaft, unbalance, reaction force, cavitation, flow rate, pressure, temperature, liquid properties, and the type of materials used in impeller manufacturing. The most common problem affecting impeller pumps vibration is the cavitation phenomenon. The use of net positive section head (NPSH) is one way to detect water pump cavitation. The NPSH is a measure of the pressure experienced by water on the suction side of a water pump. It is used to avoid running a pump under certain conditions that could cause cavitation formation [5].