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Impact of biofouling in intake pipes on the hydraulics and efficiency of pumping capacity

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ABSTRACT

Colonization of cooling water systems (CWS) by fouling organisms is a major concern for industries, power, and desalination plants over the world. Biofouling results in, depending on the dimensions of the biofouling species and growth patterns, an increased wall roughness and reduction of the inner pipe diameter. This leads to a significant head loss in the intake structure. To prevent settlement and growth of fouling species, an effective antifouling treatment is required. However, fouling mitigation must be applied from early start of operation of an installation, as several species cannot be fully mitigated (chemically) or removed (physically) after settlement, as some of them (e.g. barnacles, the Japanese oyster and Rock oyster) cement themselves to the surface. This means that even after a physical cleaning, part of the organisms remains on the surface, resulting in an irreversible increased head loss and a decreased pump capacity. To provide some clearance on the impact of biofouling on pump capacity in CWS, two cases have been studied. The results show that nonoptimal fouling treatments result in significant additional annual energy consumption. Even after complete physical cleaning, the remaining head loss is above the design line due to the increased wall roughness and results in decreased pump capacity. The results strongly emphasize the necessity to apply an effective biofouling control during the start-up of a water intake system prior to commercial operation, or to have system design parameters which take into account the irreversible effects of biofouling.

Keywords: Biofouling; Hydraulic impact; Cooling water intake; Pump capacity; Chlorination

1. Introduction

Industries worldwide abstract enormous volumes of surface waters to cool their operation processes, e.g. power plants, (petro)chemical installations, waste incinerators, etc. In addition, desalination plants apply seawater as a source to produce potable water or process water. The larger facilities are mainly located at coastal areas using seawater for cooling or makeup water. The intake facilities can either be open, directly located on the seashore, or using a submerged intake pipe with an intake head located below sea level. In this article, we focused on seawater intake facilities; however, they will also be applicable for fresh or brackish water cooling systems.

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