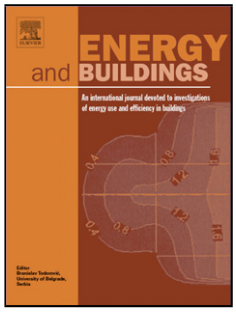

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Long-Term Predictive Maintenance: A Study of Optimal Cleaning of Biomass Boilers

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Abstract

Combustion in a biomass-fired boiler causes build-up of soot, which reduces the heat transfer and decreases the efficiency of operation. In order to mitigate this natural occurrence, cleaning via soot blowing is an important maintenance action. The objective of this study is to develop long-term optimal maintenance strategies, which are model-based and specifically employ the dynamics of boiler efficiency and of anticipated heating demand, both of which are identified from empirical data. An approximate dynamic programming algorithm is set up, resulting in the optimal maintenance actions over time, so that the total operational costs of the biomass boiler plus the cleaning costs are minimised. A practical case study with real data is used to elucidate the benefits of the new approach.

Keywords: optimal maintenance, energy efficiency, biomass boilers, dynamic programming

1. Introduction

Biomass boilers are one of the promising future avenues for heat generation [1], and have been recently deployed significantly in the United Kingdom, due to vigorous governmental subsidies [2]. However, they have arisen several concerns, ranging from hardware design [3] to dynamic control [4]. The main reason is that biomass boilers have longer response times than gas or coal boilers. Poor hardware design and installation, as well as inappropriate and overly reactive control, may result in frequent on/off switching that is very inefficient.

Another difficulty is what is known as fouling. On the surfaces of the heat exchangers, soot is accumulated during operation. It causes worse heat