



Optimal allocation of cleanings in heat exchanger networks



Bruna C.G. Assis^{a,1}, Julia C. Lemos^a, Eduardo M. Queiroz^b, Fernando L.P. Pessoa^b,
Fábio S. Liporace^c, Sérgio G. Oliveira^c, André L.H. Costa^{a,*}

^a Rio de Janeiro State University (UERJ), Rua São Francisco Xavier, 524, Maracanã, CEP 20550-900 Rio de Janeiro, RJ, Brazil

^b Federal University of Rio de Janeiro (UFRJ), Avenida Athos da Silveira Ramos, 149, Cidade Universitária, CEP 21941-909 Rio de Janeiro, RJ, Brazil

^c PETROBRAS/CENPES, Avenida Horácio Macedo, 950, Cidade Universitária, CEP 21949-900 Rio de Janeiro, RJ, Brazil

HIGHLIGHTS

- This paper addresses the optimization of cleanings in heat exchanger networks.
- The optimization problem corresponds to a mixed-integer linear programming.
- The solution allows a reduction in energy consumption during the network operation.

ARTICLE INFO

Article history:

Received 13 October 2012

Accepted 25 April 2013

Available online 6 May 2013

Keywords:

Fouling

Heat exchanger networks

Cleaning

Optimization

ABSTRACT

This paper addresses the identification of the optimal set of heat exchangers to be cleaned during a plant maintenance shutdown. The proposed methodology is based on the resolution of a mixed-integer linear programming problem which allows the identification of the cleaning requirements aiming to reduce costs during the interval between scheduled plant shutdowns. The linear structure of the proposed formulation avoids problems associated to multiple local optima, and the resultant problem dimension allows the analysis of large heat exchanger networks without excessive computational efforts. The application of the proposed approach is illustrated through the investigation of two heat exchanger networks. The first example explores some typical cleaning patterns and the other example demonstrates the utilization of the proposed approach applied to a real network.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Heat exchanger fouling is the undesirable accumulation of deposits over the heat transfer surface of thermal equipment. This phenomenon reduces the overall heat transfer coefficient and hence decreases heat exchangers effectiveness. Therefore, fouling is associated with several economic penalties for process plants, affecting operational costs (e.g. increase in energy consumption) and capital costs (e.g. demand of larger thermal equipment).

In order to restore heat loads in heat exchangers affected by fouling, it is necessary to clean the thermal surfaces periodically. There are several available cleaning techniques, employing chemical and/or physical agents [1]. The performance monitoring of heat exchangers can supply valuable data for determination of the period between heat exchanger cleanings [2].

Considering the resources necessary for cleaning activities (manpower, cranes, chemicals, etc.) and the increased utility consumption due to an off-line heat exchanger (if the cleaning is conducted during the plant operation), the establishment of the best moment to clean a heat exchanger becomes a trade-off problem. This task may assume a considerable complexity in heat exchanger networks, which can have a large number of different units.

Several papers in the literature addressed this problem through the analysis of the cleaning schedule optimization of a heat exchanger network during plant operation. The mathematical techniques employed encompass mathematical programming [3–7] and stochastic methods [8,9], where the main system investigated was the fouling mitigation in crude preheat trains of petroleum refineries.

In the early 2000s, Georgiadis and Papageorgiou [3] used mathematical programming for solving the schedule optimization of heat exchanger network cleanings employing a mixed-integer linear programming (MILP) formulation. Avoiding linearizations which could cause inaccuracies, Smaïli et al. [4] proposed a mixed-

* Corresponding author. Tel.: +55 2181052084.

E-mail address: andrehc@uerj.br (A.L.H. Costa).

¹ Present address: Petróleo Brasileiro S.A. (PETROBRAS), Avenida Horácio Macedo, 950, Cidade Universitária, CEP 21949-900 Rio de Janeiro, RJ, Brazil.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات