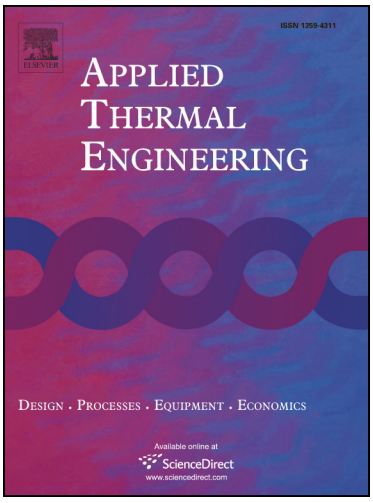

Research Paper

An energy efficient middle vessel batch distillation: techno-economic feasibility, dynamics and control

Amiya K. Jana

PII: S1359-4311(16)32243-8
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.106
Reference: ATE 10419

To appear in: *Applied Thermal Engineering*

Received Date: 8 October 2016
Revised Date: 10 May 2017
Accepted Date: 20 May 2017

Please cite this article as: A.K. Jana, An energy efficient middle vessel batch distillation: techno-economic feasibility, dynamics and control, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.106

An energy efficient middle vessel batch distillation: techno-economic feasibility, dynamics and control

Amiya K. Jana*

Energy and Process Engineering Laboratory, Department of Chemical Engineering, Indian Institute of Technology−Kharagpur, India−721 302

Abstract

This work aims at developing a novel middle vessel batch distillation (MVBD) through thermal integration route. At first, an internally heat integrated distillation column (HIDiC) configuration is devised for techno-economic feasibility. Under this scheme, the MVBD is divided into rectifying and stripping sections, which are proposed to act as heat source and heat sink, respectively. Utilizing the internal heat source, the utility consumption gets lowered in both reboiler and condenser. Aiming to further improve the energetic potential of this HIDiC configuration of the MVBD column, the vapor recompression (VRC) mechanism is introduced, yielding a hybrid HIDiC-VRC scheme. For a meaningful comparison between all these MVBD column configurations, one needs to operate them at the close, if not same, dynamical response. For this, an open-loop control policy is developed to ensure the optimal use of internal heat source in both the HIDiC and VRC schemes. The proposed HIDiC and HIDiC-VRC structures are evaluated by estimating their respective energy savings of 43.25 and 83.5%, and total annual cost (TAC) savings of 1.17 and 29.17% with reference to a conventional MVBD column. Finally, a comparison of these HIDiC-based schemes is made with the VRC-only of the MVBD.

Keywords: Middle vessel batch distillation; internal heat integration; vapor recompression; techno-economic feasibility; energy savings; control

* Corresponding author. Tel.: +91 3222 283918; fax.: +91 3222 282250;
E-mail address: akjana@che.iitkgp.ernet.in (A. K. Jana).