

**RETROFIT MODEL WITH RELOCATION
FOR HEAT EXCHANGER NETWORK DESIGN**



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ABSTRACT

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Thesis Advisors: Asst. Prof. Pramoch Rangsunvijitand and Dr.
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This research proposes a solution method based upon mathematical programming for a Heat Exchanger Network (HEN) retrofit. The retrofitting of HENs is a common project to reduce plant operating costs, including utility costs. A retrofit design consists of four features, such as the addition or removal of the heat exchanger area, adding a new heat exchanger, repiping, and splitting. Four features were used to design a HEN by GAMS and Visual C++. The retrofit in this research has two steps (retrofit, and relocation). The stage model, using the mixed integer linear programming (MIP) of Yee and Grossmann (1990), was used to develop the retrofit model. Not only was minimization of the utility cost, but also minimization of the addition or removal area were of concern in the optimal design of the heat exchanger network. HEN problems from literatures and a crude preheating train with light and heavy crude oil feeds were used to demonstrate the effectiveness of the approach in terms of the solution quality and time. These examples are retrofitted with relocation, and the estimated result of the retrofit, was a 6 % to 40 % energy saving at hot and cold utilities.

บทคัดย่อ

นพณัฐ เรือนกุล: แบบจำลองแบบรีโทรฟิตพร้อมรีโลเคชันสำหรับการออกแบบระบบเครื่องแลกเปลี่ยนความร้อน อ.ที่ปรึกษา ผศ.ดร. กิติพัฒน์ สีมานนท์

งานวิจัยนี้ได้นำเสนอวิธีการแก้ปัญหาการออกแบบระบบเครื่องแลกเปลี่ยนความร้อนแบบรีโทรฟิตโดยใช้โปรแกรมทางคณิตศาสตร์ การออกแบบแบบรีโทรฟิตนี้ได้รับความสนใจและศึกษาโดยทั่วไปเพื่อที่ลดค่าใช้จ่ายต่างๆในโรงงานเช่นค่าสาธารณูปโภค การออกแบบแบบรีโทรฟิตในงานวิจัยนี้ประกอบไปด้วยสี่วิธีคือ การเพิ่มหรือลดพื้นที่ผิวของเครื่องแลกเปลี่ยนความร้อน การเพิ่มเครื่องแลกเปลี่ยนความร้อนตัวใหม่ การเปลี่ยนสายและการแยกสาย สำหรับสี่วิธีนี้จะถูกใช้สำหรับการออกแบบระบบเครื่องแลกเปลี่ยนความร้อนผ่านทางโปรแกรมแกมส์ (GAMS) และโปรแกรมภาษาซี การออกแบบแบบรีโทรฟิตประกอบไปด้วยสองขั้นตอน คือ ขั้นตอนรีโทรฟิตกับขั้นตอนของการรีโลเคชัน แบบจำลองแบบสแตจของอีและกรอสแมน (1990) ถูกนำมาศึกษาในงานวิจัยนี้ในรูปแบบของโปรแกรมเส้นตรงแบบตัวเลขผสม งานวิจัยนี้ไม่เพียงแต่เรื่องค่าสาธารณูปโภคที่เราต้องคำนึงถึงแต่ยังมีค่าใช้จ่ายในการลงทุนที่ต้องทำให้ไม่มากเกินไป แบบจำลองที่ได้ถูกพัฒนาในงานวิจัยนี้ได้ทดลองในการออกแบบระบบเครื่องแลกเปลี่ยนความร้อนต่างๆจากงานวิจัยอื่นๆ ระบบพวกนี้ได้ถูกออกแบบใหม่โดยวิธีรีโทรฟิตด้วยรีโลเคชันและสามารถลดพลังงานได้ถึง 6 % ถึง 40 % เลขที่เดียว

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