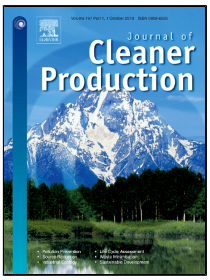
Accepted Manuscript



Frontiers in Process Development, Integration and Intensification for Circular Life Cycles and Reduced Emissions

Timothy G. Walmsley, Petar S. Varbanov, Rongxin Su, Benjamin Ong, Nathan Lal

PII:	S0959-6526(18)32374-6
DOI:	10.1016/j.jclepro.2018.08.041
Reference:	JCLP 13825
To appear in:	*Journal of Cleaner Production*
Received Date:	31 July 2018
Accepted Date:	04 August 2018

Please cite this article as: Timothy G. Walmsley, Petar S. Varbanov, Rongxin Su, Benjamin Ong, Nathan Lal, Frontiers in Process Development, Integration and Intensification for Circular Life Cycles and Reduced Emissions, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.08.041

Frontiers in Process Development, Integration and Intensification for Circular Life Cycles and Reduced Emissions

Timothy G. Walmsley[1,*], Petar S. Varbanov[1], Rongxin Su[2], Benjamin Ong[3], Nathan Lal[3]

[1]Sustainable Process Integration Laboratory - SPIL, NETME Centre, Faculty of Mechanical Engineering, Brno University of Technology - VUT Brno, Technicka 2896/2, 616 00, Brno, Czech Republic

[2]State Key Laboratory of Chemical Engineering, School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, China

[3]Energy Research Centre, School of Engineering, University of Waikato, Hamilton, New Zealand

*walmsley@fme.vutbr.cz

Abstract

Engineering tools and methods based on Process Integration have flourished in recent years. The Process Integration methodology represents a key pathway to achieving high levels of sustainability and leading to cleaner production. The means of achieving those goals are based on integrating process operations for reusing secondary streams carrying residual heat, cold, mechanical work, and water, while also expanding the vision to the waste management and supply chain. This review discusses the latest developments through the lens of achieving cleaner production in the areas of energy integration and intensification, sustainable production and planning, CO_{2eqv} footprint reduction, and waste and wastewater management. The focus is given to the roles of process development, integration and intensification in the research methods. Key results of this review include: (1) New studies on cleaner production should consider all aspects of sustainability including economic, environmental and social; (2) More emphasis on developing complete practical engineering solutions to achieve cleaner production is needed; and, (3) Substantial cleaner production benefits can arise from extending the scope of integration to cover energy, materials, water, and supply chain.