THE APPLICATION OF INTEGRATED SUSTAINABILITY TOOL FOR SEPARATION OF BENZENE AND TOLUENE MIXTURE

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INTRODUCTION

Sustainability can be divided into three different dimensions as shown in Figure 1, which are one-dimension (1-D) [1-2], two-dimension (2-D) [3] and three-dimension (3-D) [4]. Sustainability tool was developed to assess and improve the sustainability of a process. However, the current developed sustainability tools are only based on one dimension of sustainability index, which mostly are 1-D sustainability [1].
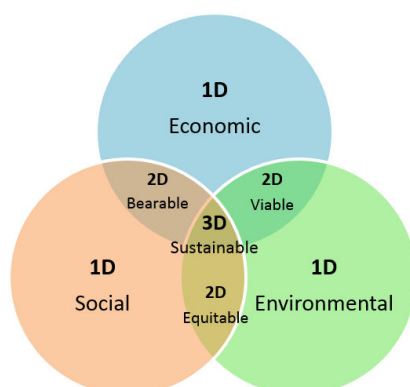

Figure 1. Venn diagram of sustainability criteria.

This objective of this paper is to illustrate the application of an integrated method for assessing sustainability index of distillation columns systems. Three different dimensions of sustainability index, which are 1-D, 2-D and 3-D will be calculated simultaneously with only a single analysis. The performance of the developed sustainable tool was tested with the separation of benzene and toluene mixture.

The framework of the developed integrated sustainability tool consists of four parts: introduction, components selection, data input and analysis. The objective of the first part is to introduce the user to the process on the distillation column systems. Then, the users have to select components which involved in the process in the second part. Next, in the third part the users need to key in the necessary data, such as feed and product flowrates

and composition, energy for condenser and reboiler, and others required data. Lastly, is the analysis part which objective is to analyze and display the calculated value.

MAIN RESULTS

The developed tool was tested with the separation of benzene and toluene mixture. The data required for the tool were obtained from the highest point of driving force that used to design the distillation column. The tool was successfully calculated the 1-D, 2-D and 3-D sustainability index simultaneously in an easy, systematic and efficient manner. All calculated values are displayed in Table 1.

Table 1. Analysis of separation of benzene and toluene mixture by using Sustainability Calculator

		Weight	Index	Overall
1D	Social Index	0.40	0.4806	**0.2562**
	Economic Index	0.20	0.0000	
	Environmental Index	0.40	0.1598	
2D	Mass Intensity Index	0.33	0.2827	**1.0410**
	Water Intensity Index	0.33	0.1525	
	Energy Intensity Index	0.34	2.6393	
3D	Potential Environmental Impact	0.30	0.0012	**0.7270**
	Potential Chemical Risk	0.30	0.0001	
	Material Intensity	0.20	0.9938	
	Non Renewable Energy Intensity	0.20	2.6393	

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