CHAPTER I

INTRODUCTION

In recent years, interest in environmental stewardship has increased around the world. Energy consumption and emissions associated are key elements to be considered for sustainable development. The current concerns about global warming have been placed on energy and transportation sectors as major contributors of greenhouse gases (GHGs) emissions. Vehicles, fuel usage and road have contributed significant impacts on the environment, economy and society. For road development, all phases from construction to operations consume large amounts of ecosystem goods, energy, and also generate waste and emissions. In road construction, energy consumption and environmental impacts are associated with acquisition of raw materials such as cement, bitumen and asphalt, production, and pavement processes. Particularly, production of conventional asphalt or hot-mixed asphalt (HMA) is an energy intensive process which requires high energy consumption to heat the aggregates and binder and asphalt in order to maintain a low viscosity for a sufficient workability and level of compaction. The increased energy and environmental awareness have led to a development of new type of asphalt or warm-mix asphalt (WMA) as a substitute for conventional HMA. WMA is a generic term for an asphalt mixture which is mixed and placed at lower than conventional temperatures (16–55 ^{o}C lower than typical HMA) (Newcomb, 2005). A reduction in energy requirements associated with the production of this mixture of up to 55% has been reported (Kristjánsdóttir et al., 2007). Moreover, its benefit is reduced emissions during production and placement.

The main objective of this study is to assess the energy resources and environmental impacts of warm-mixed asphalt (WMA) and compare with hot-mixed asphalt (HMA). The scope of the research covers the inventory data collection and environmental impact assessment throughout the entire life cycle of asphalt based on cradle-to-grave approach. This includes raw materials acquisition, asphalt production, pavement and transportation. The input data including raw materials and chemicals usage, energy consumption and utilities and the output data including emissions to air, water and soil were collected as primary data from actual sites and as secondary data from literature and calculations. The collected data were analyzed by using LCA software, SimaPro 7.0, with Eco-Indicator 95 and CML 2 baseline 2000 methods to identify the environmental burdens in various impact categories such as global warming, ozone layer depletion, acidification, and eutrophication. The results were compared with HMA to identify the benefits of WMA. Finally, suggestions for improvements are offered.