CHAPTER 1

INTRODUCTION

In this chapter represents 6 topics viz, rationale and motivation, research objectives, scope and limitation of the dissertation, anticipated outcomes of the thesis dissertation, dissertation structure, and references.

Rationale and Motivation

Over 60% of energy produced in the Thailand is wasted as heat, which can be directly converted into electrical energy using TE materials through Seebeck effects discovered by Thomas Seebeck (Chen Z.G., Han G., Yang L., Cheng L., Zou J., 2012, pp. 535–549). TE technology has been used in military and aerospace applications as a reliable, safe, and durable power source for many space programs to the outer solar systems (A. Sanchez-Torres, 2011). However, the potential of using TE technology for thermal energy harvesting in civil infrastructures has not been explored, despite a large quantity of waste heat is available including thermal storage in concrete structures, building envelopes, and waste heat in heating, ventilation, and air conditioning (HVAC) systems. For instance, the surface temperature of the concrete infrastructure can increase up to 60 ^{o}C in hot climate, while the air temperature remains at 32 ^{o}C. This opens up an opportunity for using TE technology to scavenge the wasted thermal energy into electricity. The thermoelectric materials have been developed for solution of energy problem. The cement is the large scale of materials in the world. Jian Wei et al. enhanced thermoelectric efficiently of cement by added with metallic oxide microparticles (5 wt% Bi_2O_3 powders) and obtained the Seebeck coefficient about 100.28 μV/K (Wein J., Hao L., He G., Yang C., 2014; pp. 8261 – 8263). Furthermore, the power factor 7.85 × 10^{-4} μW/m K of expanded graphite/carbon fiber cement composites was also reported by Jian Wei et al.

(Wei J., Zhang Q., Zhao L., Hao L., Nie Zh., 2017; pp. 10763–10769). Moreover, thermoelectric figure of merit (ZT) was reported 9.33×10^{-5} by cement added with carbon nanotubes (Wei J., Fan Y., Zhao L., Xue F., Hao L., Zhang Q., 2018; pp. 5829 – 5833). Then this research is study thermoelectric properties of Portland cement (PC) added with nano ZnO for increasing Seebeck coefficient and electrical conductivity and for possibility of cement thermoelectric application.

Dissertation Objectives

1. To prepare Portland cement and nano ZnO–added Portland cement thermoelectric by mixtures method.

2. To study characteristic, crystal structure and thermoelectric properties of Portland and nano ZnO–added Portland cement.

3. To study possibility of cement thermoelectric application.

Scope and Limitation of the Dissertation

1. Using Portland cement of SCG (PC–A), TPIL (PC–B), TPIL299 (PC–C), Lion (PC–D), Lotus (PC–E) and Eagle (PC–F).

2. 2. PC added with ZnO (10%, 20%, 30%, 40% and 50%)

Anticipated Outcomes of the Thesis Dissertation

1. Portland cement thermoelectric.

2. Development direction of Portland cement thermoelectric.

3. Rule of commercial Portland cement thermoelectric.

Dissertation Structure

The dissertation structure includes 5 chapters, namely, introduction, literature reviews, experimental, result and discussion, and conclusion. In the chapter 1 introduction consist rationale and motivation, research objectives, scope and limitation of the dissertation, anticipated outcomes of the thesis dissertation, and dissertation

structure. The literature reviews of theorem of thermoelectricity, cement thermoelectric, Zink oxide are present in chapter 2. In the chapter 3 are present the step detail of prepare p–type Portland cement and n–type ZnO added Portland cement, characterization, thermoelectric module fabrication and measurement. The results and discussion of experimental are present in chapter 4. In the final, chapter 5 are present the conclusion of the work. In addition, the reference and appendix are present after chapter 5.