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Research

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Evaluation of CO₂ Emissions Reduction Strategies in the Iranian Cement Industry

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ABSTRACT

Portland cement, as the main constituent of conventional concrete, is the most widely used cementitious material in the construction industry. But Portland cement production has major environmental disadvantages, including high energy consumption and carbon dioxide (CO₂) emissions. So the production of Portland cement is accounted for 7 to 10% of global CO₂ emissions. Considering the amount of Portland cement production and CO₂ emissions in Iran, it can be concluded that Iran is facing environmental problems caused by cement production. Hence, various CO₂ emissions mitigation strategies of the Iranian cement industry have been evaluated in this study. This research work applied Analytical Hierarchy Process (AHP) method to evaluate and prioritize mitigation strategies. The obtained results showed that among the 16 strategies studied, clinker substitution (blended cement) and production of low carbon cement such as geopolymers were recognized as the most important strategies to reduce CO₂ emissions in the Iranian cement industry.

Keywords: AHP, CO₂ emissions, Portland cement, Sustainable development, Green management.

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1. INTRODUCTION

Concrete is the most consumed material after water. As the demand for concrete rises, so makes the consequent demand for Portland cement, as the main component of concrete [1]. But production of Portland cement has major environmental disadvantages, so that it is identified as one of the major sources of carbon dioxide (CO₂) emission and one of the most energy-intensive industries in the world [2]. Production of 1 ton of Portland cement releases approximately 0.73-0.99 tons of CO₂ into the environment [3]. On the other hand, Climate change due to global warming is currently one of the most significant

environmental challenges. Greenhouse gas emissions are the main contributing factor to global warming, with CO₂ having the greatest share (65%) among other greenhouse gases. Cement manufacturing is accounted for 7 to 10% of global CO₂ emissions [4]. Besides CO₂, the cement industry accounts for significant emissions of carbon monoxide (CO) and heavy metals [5]. The cement production process includes 3 main sections: preparation of raw materials, clinker manufacturing, and production, bagging, and transportation of cement. Among these sections, clinker production has the highest CO₂ emissions. In general, 50% of CO₂ emissions are related