Material Selection for the Next Generation
Wave Energy Extraction Impulse Turbine

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ABSTRACT
The Oscillating Water Column wave energy harnessing method is considered as one of the best techniques of converting wave energy into electricity using self-rectifying turbine. A new way is developed for selecting alternative materials for the turbine blades. The approach taken was a combination of adapted value engineering techniques and the Cambridge Material Selector based method. Using this approach allowed the user to combine the strength of each separate method, allowing the material selection process to be streamlined. The material selection exercise indicated that the optimum material for manufacturing an impulse turbine blade would be titanium alloy, with nickel alloy in second place. However cost and manufacturing practicalities need more detailed consideration before a final decision is made.

KEY WORDS: Wave energy; impulse turbine; blade material selection; CMS; V.E.

INTRODUCTION
The Oscillating Water Column (OWC) wave energy harnessing method is considered as one of the best techniques of converting wave energy into electricity. It is an economically viable design due to its simple geometrical construction, and is also strong enough to withstand against the waves with different heights, periods and directions. The design (see Figure 1) consists of an OWC chamber and a circular duct, which reciprocally moves the air from and into the chamber during the process of wave approach and retreat. A self-rectifying turbine mounted inside the duct is designed to turn in one direction only although the airflow moves bi-directionally (Falcão, 2003). A matching generator is coupled to the turbine to produce electricity.

The impulse turbine model (0.6m diameter, 0.6 hub-to-tip ratio) that is currently being tested at the University of Limerick bi-directional test rig was manufactured using Rapid Prototyping Fused Deposition Modelling (FDM) (Thakker et al., 2002). The material chosen was ABS Plastic which is adequate for the prototyping method developed. The actual turbine being designed will be a scale-up of the experimental model, and will operate under marine environmental conditions. Therefore this design will incorporate heavier blades which will be manufactured with a selected optimum engineering material.

Engineering design is increasingly driven by the objectives of performance, cost and environmental sensitivity. All three, very frequently, are limited by materials. The goal of the present work is to provide a novel method for converting design requirements into an optimal material choice, while being applicable to problems of industrial interest. To this end a new material selection procedure which combines the Cambridge Engineering System (CES) based method and adapted Value Engineering (VE) techniques is proposed.