ANALYSIS OF POSSIBILITY OF ADAPTATION REGENERATION CONCEPT FOR ENGINE DRIVEN EMPTY CONTAINER HANDLERS

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Degree of Master of Science

Department of Electrical Engineering

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DECLARATION

I declare that this is my own work and this dissertation doesn't incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it doesn't contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Dr. A.M. Harsha. S. Abeykoon ----------

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ABSTRACT

Empty container handling operations in inland container depots is a major economic and environmental problem today due to fossil fuel burning. This research examines reuse of braking and reverse energy to reduce fuel cost and environmental impact. The research was originated within the domain of electrical regeneration means as most of the known regeneration applications are electrical energy related. However regeneration by means of hydraulic energy was selected as Linde-II, base- equipment to the research is hydraulic based.

One major innovative step taken in this project is application of discharge pressure of the accumulator to suction side of the gear pump. This is a novel concept which have not patented yet anywhere in the world. The energy saving potential of the proposed reengineering solution is estimated to be 33%. Saving potential of the solution is substantial and lucrative. Simulation results were used to validate the reengineering solution in terms of power reduction. Actual fuel consumption of the proposed solution may defend on the way engine is controlled. Simplicity and low capital cost are two positive aspects of the solution. Even though the saving potential was impressive, it could not be implemented into a prototype mainly due to non availability of suitable gear pumps. Therefore solution is limited to a concept for this moment.

It is essential to have a positive engine control with respect to accumulator action in order to obtain optimum possible fuel savings. Whilst the accumulator is charging and discharging, there is an effect on lifting and lowering speeds. Variations in lowering and lifting speeds due to the proposed solution could affect performance related to the users' needs, however it has not been considered within the scope of the research. Main research areas precede parallel to this study are: recovery of braking energy, development of an engine control algorithm, a study on variations of lifting and lowering speed, and a reliability assessment of the proposed reengineering solution.

This concept is novel and can be defined as a green supply chain initiative in which outcomes lead to a reduction of green house gas emissions, and also to reduce carbon footprint in the shipping industry.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ACM	Alternative Current Motor
BLDC	Brushless DC motor
CO	Carbon Monoxide
CO2	Carbon Dioxide
CRPS	Common Pressure Rail system
CVT	Continuous Variable Transmission
DC	Direct Current Motors
ECH	Empty Container Handlers
ECM	Engine Control Module
ECM	Electronically Commutated Motor
GSC	Green Supply Chains
HBRS	Hydrostatic Regenerative Braking System
HLA	Hydraulic Launch Assist
ICE	Internal Combustion Engines
IFAS	German Institute for Fluid Power Drives and Controls
IVT	Infinitely Variable Transmission
NEDC	New European Drive Cycle
N2O	Nitrous Oxides
PM	Particulate Matter
RS	Reach Stackers
RTG	Rubber Tyred Gantries
SR	Switched Reluctance

SC	Straddle Carriers
SSC	Ship to Shore Cranes
TEU's	Twenty feet Equivalent Units
VOCs	Volatile Organic Compounds