Energy Storage on RTG Cranes

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Introduction

As our understanding of the world around us increases it is fast becoming apparent the worlds resources are finite. This has lead to the ‘Peak Oil’ problem, it is now widely accepted that we are approaching or at a point at which world oil production will begin to decline. This means that economies are having to adjust to a future of increasing fuel costs. It has also been established that we are producing too much Green House Gas (GHG) for the planet to balance out and are irreversibly affecting the worlds ecosystems. In order to deal with this treaties like the Kyoto accord have been signed, with member countries pledging to reduce GHG emissions. The UK Government has pledged an impressive 80% reduction by 2050. In order to meet this level industry is having to implement technology to reduce emissions from their processes. The UK’s port facilities produced nearly 2% of the UK’s total GHG emissions in 2010. They have identified areas where savings can be made, the cranes used for transporting containers around the facility are large fuel consumers and as such produce significant GHG emissions. The Rubber Tyred Gantry (RTG) Crane is used for this purpose, as such this study concentrates on energy storage solutions for RTG Cranes used at port sites.

The Crane

The RTG Crane is powered by a diesel generator unit.

- Diesel generators burn diesel to produce electrical energy.
- It means that GHG’s are produced for every operation of the crane. But it has the freedom of movement needed.
- Port of Felixstowe operates over 100 cranes to meet the demand on its facility, operating for 22 hours a day this means significant GHG emissions.
- As port facilities are localised industry and generally near a population centre, this helps with distribution away from the site via road and rail links.
- Induction machines in the crane draw energy from the generator during lift or drive actions, but under certain conditions these machines may generate energy.
- This project seeks to exploit these conditions to help reduce fuel consumption and emissions.
- There is potential for this to be extended beyond RTG Cranes to Straddle Carriers.

Energy Storage

Energy Storage on RTG Cranes

Regeneration

However should the rotor turn faster than the rotating field then the energy transfer actually reverses turning the machine into a generator.

- This happens under a number of circumstances, any time the rotor torque exceeds that of the electromagnetic torque.
- On the crane this happens when a container is being lowered or when the crane is slowing after a movement.
- Currently this energy is not used, any regenerated energy is dissipated through a ‘brake resistor’.
- All the regenerated energy is wasted as heat.
- The duty cycle of the crane means that it regularly alternates between periods of motoring and generating.

Energy Drive System

The drive for the cranes motions are provided by Induction Machines. They work by the principles of electromagnetic induction and the implementation of rotating magnetic fields.

- Coils on the stationary section produce a rotating magnetic field.
- Coils or bars on the rotor experience a force due to this.
- This force across the rotor produces rotation.

Under this motoring condition the rotor does not move faster than the magnetic field.

Energy Storage

Energy Storage

An energy storage device is a component that stores energy from a system.

- One operation is as a power multiplier.
- Energy is stored on the device and used to provide energy to the system in-place of the diesel generator.
- This allows the diesel generator to do less work and hence consume less fuel.

Project Aims

- To design and develop a computer model of an RTG Crane.
- To construct a test rig that can be run alongside the computer model.
- To implement a power control system to maximize the benefits of energy storage.
- To construct the system for use on a crane at a port facility.

References


Contact information

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