Electrifying the RTG

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In the container terminal arena, it could be argued that rubber-tyred gantry cranes (RTGs) are the workhorses of the industry, since they are one of the most ubiquitous pieces of equipment used for container handling. The main contemporary challenges for RTGs have revolved around how they interface with a number of yard terminal tractors in the transportation of containers. Currently, the average number of gross container moves per hour is eight, and with the increasing demands for faster productivity, efficiency and safe operations, many terminals are seeking ways to improve.

In recent years, due to the high costs of fuel, attempts have been made to reduce the utilisation of RTGs. For many container terminals, RTGs constitute one of the largest users of diesel fuel, which can represent as much as 50% of total energy costs. One of the major attempts practiced by terminals aimed at negating this outlay has been to introduce hybrid motors and electrification.

Electrification

The introduction of cables and reels to electrify RTGs was first considered in China, and the first electrified rubber-tyred gantry crane (eRTG) was unveiled at SheKou Container Terminal (SCT) in August, 2008.

As China is considered the largest market for RTGs, representing nearly 60% of the world's fleet, its main motivation has been on identifying improvements. One such technology that has been trialled is the use of the 'high wire' system. The Port of Shanghai practiced this by installing 40km of overhead wires to power 130 RTGs. The main obstacle in further developing this type of technology was the large costs for the civil works required for the installation of steel towers to hang overhead wires throughout the container yard. This led to other solutions for full electric RTGs being quickly identified and implemented, such as cable reels and conductor bars.

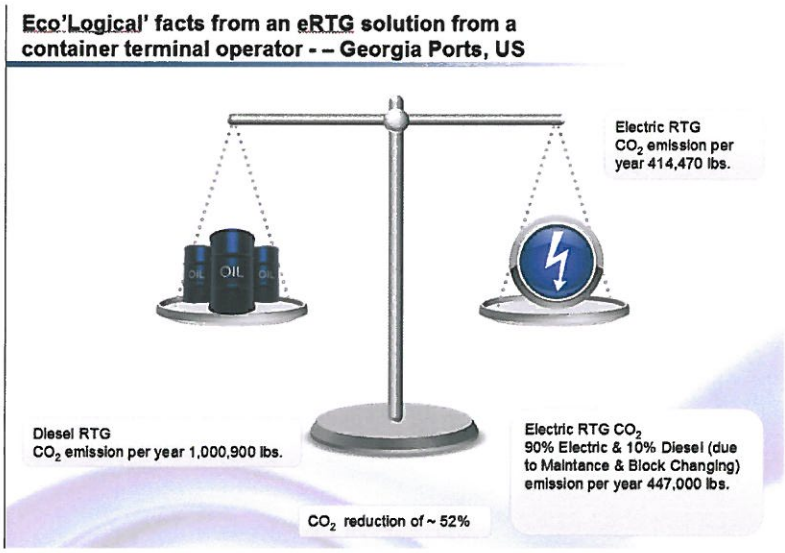

Figure A

The concept of an eRTG with a plug-connection was a relatively simple one. Electrical energy is provided through a conductor-rail system running alongside a container block. The support structure of the conductor rail also includes guidance for a collector trolley. A towing rope attached to the travelling RTG pulls the trolley, which holds the current collectors for three-phase and earth connection. A cable and a plug maintain the connection between the RTG and the rail system. The plug-in method is proven as a practical, safe and reliable system, with several hundred installations world-wide.

In Figure A, an illustration is given in which data from a real container terminal was analysed by comparing its current fleet of diesel-powered RTGs with RTGs retro-fitted with electricity.

Many container terminal operators view conductor rail solutions as a significant improvement. Also, with advances in smarter terminal operating systems (TOS), improved education and training for RTG staff, the management of container terminal yards now requires smart solutions that are part of an overall system, rather than operating with stand-alone solutions.

Challenges for terminal operators

The importance of RTG solutions to integrate easily and seamlessly with current RTG systems is deemed by many experts to be paramount for any retrofitting project. As the retrofitting of an existing RTG can be a complex project, the container management decisions are driven by operational requirements. Some of the major challenges raised by container terminals in using cable reels include:

- Significant additional weight and possibly mechanical structural modifications on the RTG
- The need to unplug and plug-in again to change aisles

ELECTRIC RTG IN LAZARO CARDENAS, MEXICO

- Cable alignment between RTG and container stack and additional cable protection to avoid damage
- Additional measures have to be taken if a number of RTGs are to operate in any one lane

A current challenge for container terminal operators is information transmission alongside the electric transmission solutions. Many container terminal operators are initially considering low-density 'process' data being transmitted to the TOS, or other control software. This is a step on the way to the full automation of eRTGs. As illustrated in Figure B, many experts view the implementation of technology for electrification along with the integration of communication systems as a key step on the journey to the automation of RTGs.

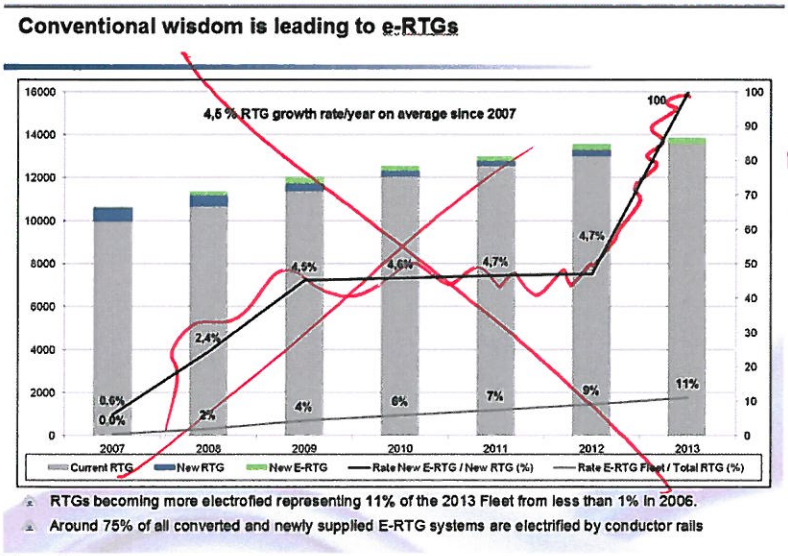

Figure B

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Solutions

A key method in helping ports is to put in place a system that is not just able to be integrated into the TOS as it stands, but can also be a platform for the further development of remotely operated, semi or fully automated, eRTGs. To this end, ports are looking at a high data-transfer rate – around 100 megabits per-second – which can send real, lifelike images to the control room that enable the eRTG to be driven remotely.

One technology that is being considered in data-communication for RTGs is the slotted microwave guide (SMG) data transmission system, articulated in Figure C.

SMG has been proven in automation technology for contactless and interference-free transmission at high data rates of up to 100 megabits per second. It opens up a wide range of applications through its variable design, and it can operate parallel to a conductor rail system. Some of the key features of the SMG are:

- Immunity to interference due to isolation of the SMG profile from the surroundings
- Maintenance-free due to contactless transmission technology
- Error-free transmission of high data rates
- Simultaneous transmission of up to six data channels
- Emergency-off transmission
- Coupling of several mobile subscribers to one SMG profile
- Transmission independent of travelling speed of mobile subscriber
- No negative effects on transmission quality due to environmental influences such as temperature, humidity, clouds and dust

Inspecting cranes SMG for eRTG AT ZPMC FACILITY IN SHANGAI, CHINA

Vahle SMG-System – the components

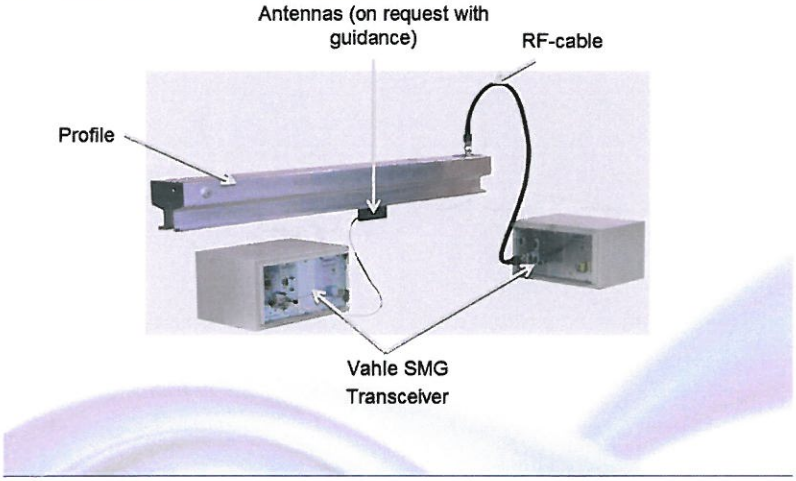

Figure C

Conclusion

eRTGs are a light-type of RTG and possess a number of advantages over traditional RTGs, such as purchase price, maintenance costs and energy consumption. Often the operating power of an eRTG is provided by an external electric power supply, instead of a large diesel generator. This will not only reduce purchase cost and largely eliminate maintenance costs, but also slash emissions and benefit the environment.

Further research by Taiwanese academics has found that the conversion of diesel RTGs to eRTGs can save a total of US$1.8 million per year. This indicates that an RTG conversion project is not only beneficial for the environment, but also an optimal means of avoiding the impact of high diesel fuel prices in the shipping industry.

Future work on the development of RTG electrification will be on lighter components that are more robust with smart technologies installed. This will allow for remote maintenance and improved performance for yard operations. In addition, integration of the software will require more open source applications, achieving results such as better visibility of containers and the terminal's assets. This implies that optimisation can be employed fully.

using conductor bar technology

About the author

Dr Lawrence Henesey assists in the development of solutions for energy and data transmission needs at ports and container terminals globally for Vahle. He has worked with clients on employing automation and electrification technologies on AGVs, ASCs, Automated cranes, RTGs and RMGs. Dr. Henesey researches on the application of techniques from Distributed Artificial Intelligence in Container Ports and Terminals at Blekinge Institute of Technology, which has culminated in 50+ published articles and two books. In addition to lecturing at several US and European Universities, Dr. Henesey is a member of the board of advisors at the Port Operations Research and Technology Centre at Imperial College London and PEMA (port equipment manufacturers association)

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About the organisation

VAHLE

Since 1912, Vahle has specialised in mobile power and data transmission. The company develops, manufactures and installs customised power and data transmission systems for various material handling applications, including port technology.

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