

# EQUIPMENT

## RTGs

### Improvements In The Rubber Tired Gantry Crane

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**T**he population of rubber tired gantry cranes in North American ports stretches from the Northeast Ports in Canada to the Pacific Northwest Port of Vancouver, BC. At least one terminal in each major container port depends upon the yard gantry crane for container management and maximum storage density.

These ports have realized the positive impact that the RTG has had upon the numbers of containers that are handled per acre at their terminals and this fact spearheaded the return of this mode of container handling during the 1990s. During the late 1990's and into the 2000's, RTG capabilities became increasingly important as vessel capacities and container volumes threatened to choke the flow of cargo through many of the gateway ports. Today, however, with ports realizing double digit down turns in container volumes and ocean carriers wrestling with fleet lay-ups in unprecedented numbers, the density issue is not as important as is the issue of reduced costs.

Despite the obvious importance of the rubber tired gantry crane to port productivity during periods of sustained high container volumes, many industry pundits are heralding an alternative equipment system, Asks (Automated Stacking Cranes). This system, now utilized in a number of terminals in Europe, has proven to reduce costs, increase container throughput, lower energy utilization and reduce the impact of port equipment upon the environment.

While most ports in the US recognize that the ASC based system may offer these advantages, they also realize that the introduction of this system will in itself entail significant re-investment, dramatic infrastructure changes and unprecedented labor management agreements. The introduction of ASC like equipment in the US is not impossible as proven by the use of unmanned, all electric rail mounted gantry cranes at the APM Terminal in Portsmouth, Virginia. However, this breakthrough, especially in labor/management relations, may not be possible in other port regions and the reluctance of labor to concede on the issue of full automation makes the ASC system difficult to envision.

Despite these realizations, it is anticipated that the eventual development of terminals with ACS will reduce manning levels, cut energy use, vastly improve the level of emissions and with higher, wider footprint, increase the volume handled per terminal acre. In addition, benefits include the potential for continuous or at the least, house keeping activities can be conducted 24 hour operations per day without a full manning level.

The primary impediment to ASC development in the US will be the labor management interaction relative to the capability to automate these machines so that they operate without a driver. The second impediment will be the cost of implementation and

ports may only implement this technology in areas where new terminals are being constructed.

The APM terminal employs 30 cranes that are man less and controlled by eight highly trained longshoremen housed in a tower overlooking the facility. The rail mounted gantry cranes are computer controlled, electrically powered, rail mounted, quiet and fast. They are not however, wide span or extremely high, providing the density capable of an ASC. One of the most important impacts of the APM Terminal is the fact that as difficult as it would appear to automate terminals in the United States, it is possible.

With this in mind, it appears that the RTG as the solution for the long term future could be questionable. However, a number of things including the inability to reduce the cost of labor may divert the attention of port operators from the ASC in North America and focus their development of the rubber tired gantry crane.

While one should not mention that the RTG may not be the ultimate tool for increased density and reductions in cost, energy use and environmental impacts to RTG manufacturers. Fierce competitors, all major rubber tired gantry crane manufacturers have become extremely aggressive toward crane developments that will vastly improve many of the negatives versus automated stacking cranes.. As reported in an earlier article, the RTG market is rebounding and is again approaching 500 units per year. Most of these units will be delivered with innovations that will reduce energy consumption, reduce harmful air emissions and incorporate technological improvements to assist in the control of terminal operations management. RTG manufacturers have also addressed terminal density. To date, cranes with increased stacking height and added storage rows are being produced. Seven high stacking and 8, 9 and 10 row inside spans are not uncommon.

Relative to the use of energy and environmental impacts, each manufacturer is busy refining its approach. In addition, aftermarket companies are perfecting tools to assist those operators who have cranes manufactured prior to the development of new technologies. The emphasis is on reducing energy consumption and emissions associated with diesel engines. Two approaches, usually addressing both of these issues include controlling engine operations and changing energy sources.

### **Konecranes**

Konecranes has been the leading supplier of RTGs in North America for well over ten years. As their product has evolved, they have developed technology necessary to reduce fuel consumption and emissions without sacrificing productivity and technology that would integrate their crane operations into automated terminal operating systems.

In 2006, Konecranes began a project to develop a fuel saving system for their RTGs. The objective of this system was to reduce the use of diesel fuel and noise and air pollution. Since there were solutions on the market, they began by investigating those available, discovering that their applications were costly.

Konecranes began investigating alternate systems, concentrating on the use of a programmable logic controller or PLC, to calculate the generator power needed and using this data to regulate the engine's running speed. Settling on the use of a voltage regulator different from the normal regulators, Konecranes discovered that this regulator's output was almost linear with the rotation speed of the alternator's axle. When the rotation speed

changed, the frequency and voltage changed. The voltage went from constant to variable. Konecranes' next step was to create the appropriate control algorithms for the diesel engines. Understanding the control of a modern diesel engine led to the development of the technology that provides a system that drives the diesel engine with optimal efficiency at all operating points eliminating high speed idling.

Konecranes also concluded that the RTG duty cycle was the key to fuel and emission savings and after study of actual RTG operations, established that most of the RTG usage was approximately 25% at full load and 75 to 100 percent top capacity. The final conclusion that there is a need to produce only the amount of energy really needed resulted in their PLC driven system. The PLC calculates how much power is required.

Konecranes indicates that their system is best described with demonstrated fuel savings. Their estimate of normal RTG fuel consumption was 315 litres a day whereas fuel savings with Konecranes system include consuming only 212 litres per day. Calculating this cost savings can mean up to 18,000 EUR per year.

Konecranes' fuel saving RTGs have been delivered to customers since 2007. Early customers report up to 40% fuel savings and this has risen to as high as 60%. This savings is also realized in both noise and air pollution.

In addition, Konecranes has designed and installed RTGs in Russia that will operate with a cable reel which provides increased energy efficiency, less noise and virtually zero emissions. These cranes also come with auto steer for traveling and positioning.

### **Shanghai Zhenhua Port Machinery Co., Ltd (ZPMC)**

ZPMC reports that their electrically powered RTGs can save up to 70% of machine operating costs. ZPMC has accepted orders for this new application as well as requests to retrofit existing ZPMC RTGs. ZPMC indicates that in comparing their all electric RTG with RMGs, the RTG is combines the functions of both, since customers can transfer from one container row to the next and can realize a significant reduction in operating noise and harmful air emissions compared to the operation of diesel powered cranes.

The ZPMC all electric RTG includes cable, cable reel and control system, cable guide, power cable, cable prompt connector and ground switch box and other component. The ground switch box is powered by the marine terminals main transformer. The power cable of the RTG can be connected through the cable guide by an under ground trench or cable groove or if above ground, it can be connected by an above ground cement trench.

The RTG can be moved from container row to the other by disconnecting the cable plug after switching off the power source. With a small, crane mounted auxiliary engine, the cable reel can be retracted.

ZPMC also offers a green RTG powered by diesel engine. Energy saving is accomplished by an energy saving component called a super capacitor. The application of this capacitor saves energy, protects the environment and provides economic savings. ZPMC's Super Capacitor reduces energy consumption by as much as 30% and harmful exhaust is eliminated. With the use of the Super Capacitor, the reduction of black smoke when the hoist is started after idling is greatly reduced. The diesel engine noise is also reduced between 4 and 5 decibels and the engine is stabilized for increased service life.

In accordance with US EPA standards, ZPMC had an independent testing service analyze the results of operating without the Super Capacitor and utilizing the Super Capacitor. The results of this test resulted in a reduction of the visible particle exhaust density of 58%. This test was conducted with a simulated container load at full hoisting speed.

The Super Capacitor is inserted into the poser supply circuit of the RTG. Energy can be stored when the load is lowered. During actual testing, fuel savings ranged from 29.5% to 40.6%. ZPMC guarantees the Super Capacitor for up to 4 years and anticipates that the capacitor will provide between 5 and 6 years of service life with proper maintenance.

### **Liebherr**

Customers consider Liebherr Container Cranes' RTG as one of the most fuel efficient cranes in the market today. This is accomplished through its design of the electrical drive and control systems. Liebherr has been developing today's version of its electrical system for over 40 years.

Liebherr realizes that energy savings and reduction of emissions are priority considerations with their customers and has been working to provide the most effective system possible.

Liebherr is aware of the number of energy saving systems now on the market place. They have studied virtually every concept proposed by competitors and after market developers and many of their own applications. They are presently conducting field trials with energy saving systems on their RTGs at a number of locations.

Liebherr is also working to refine its electrical control system to be able to utilize the appropriate energy saving devices and maximize their impact on the Liebherr product. Based upon much of their field work, they are also expecting to offer a retrofit package for RTGs already in use.

Liebherr is also working to produce an all electric alternative for their RTGs. They will concentrate upon the use of a cable reel, increasing energy efficiency and reducing operating costs significantly. Their concept includes the dedication of the RTG to a container stack with a cable pit or junction box will be located for plug in at either end of the stack or in the middle. Movement of the RTG will be possible with the use of an auxiliary generator or a solution that includes a mobile generator that may be shared by multiple RTGs.

### **Kalmar**

Kalmar's commitment to the environment results in a program that has developed some of the toughest environmental standards of any of the equipment manufacturers. They offer either a zero emission RTG or an all electric E-One+ RTG that comes equipped with a low-emission diesel engine. The E-One+ is also fitted with a variable speed generator (VSG) to reduce fuel consumption, especially when the power demand is low. Kalmar RTGs also include all electric trolley, wheel steer and spreader operation. Their all electric concept is applied without the use of hydraulics which means not only environmental efficiencies but increased component reliability and cost efficiency.