

## Summary

Research conducted on energy savings by implementing speed control on belt conveyors has sparked an interest in drives and drive control, with the goal to see what advantages other types of drive control can deliver and whether these advantages can also be gained on other types of dry bulk handling equipment. This interest is the basis for this literature study which has as goal to give an indication of drive requirement per category of handling equipment, an overview of drives that are used in bulk handling and an overview of different drive control methodologies with a basic explanation of each control method.

There are seven categories of which the drive requirements will be determined: ship unloaders, belt conveyors, stackers, reclaimers, stacker/reclaimers, ship loaders and railcar loaders. Unfortunately there is little data available on which type of drive is used in bulk handling equipment but the data that is available indicates that both AC and DC motors are widely used in a power range from 2 kW up to 720 kW.

The AC drive control is of the most interest because DC drive control has hardly changed over the years and is therefore well established. Normal AC drives can only work at one speed. A control system is necessary to give an AC drive more functionality. Frequency control is the oldest technique. This technique changes the frequency of the alternating current and that changes the speed at which the shaft revolves. This technique is only capable of speed control. A more complicated control technique is flux vector control. This technique calculates the torque and flux inside the motor and uses this data to control the motor. This technique is capable of both speed and torque control and is highly accurate. The latest development in AC drive control is Direct Torque Control. This technique is very similar to flux vector control but is cheaper, downside to this is that it is slightly less accurate.

The conclusion from this research is that there is very little information available on the effects of drive control on energy saving in the bulk handling sector. Additional research should be conducted in this field especially because the research conducted on belt conveyors shows very positive results which could possibly be extended to other types of equipment.