AC Induction Motors and VFD Settings

Operation fundamentals and common pitfalls

Driving many SCI products is an AC induction motor used to rotate the target during the sputtering process. This paper addresses the operation fundamentals of the motors and how the motors are used with the SCI product lines. Some of the common pitfalls to standard VFD parameter settings in controlling the motors are also discussed.

AC induction fundamentals

In an AC induction motor a magnetic field is created within the rotor (rotating magnetic component) of the motor by the supplied voltage to the stator (static winding within the case of the motor). This magnetic field created in the rotor opposes the magnetic field in the stator. These opposing fields create a torque used to rotate the load. The load on the motor may vary, which in turn causes a change in the torque needed and a change in the magnetic field. A greater load requires more torque, which means the motor draws more current from the supply voltage.

In most SCI product applications, neither full motor torque nor full current to produce the magnetic field are required. The excess current in turn produces an excess magnetic field within the motor and provides no positive effect. This current also generates reactive current, which wastes energy and introduces heat to the motor and gearbox. Excess current is even more pronounced at low torque, where reactive current increases in comparison to real or variable current.

Due to the many variables that affect torque, motors used on SCI products are often operated in an under-loaded scenario, and the VFD parameters need to be changed from the manufacturer's default settings to reduce the voltage to the motor. Reducing the voltage to the motor will in turn reduce the supplied current to the motor. VFDs that have not had their parameters optimized will cause undue heat in the motor due to over magnetizing and reactive currents.

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The voltage/frequency curve

The load on most SCI product motors is constant and less than full. Consequently constant torque is required over the entire speed range. The inductive reactance (XL) of the motor's stator coils is expressed as (XL = 2πfL) and is proportional to the applied frequency. This is the constant "volts to hertz" (V/Hz) ratio used by most variable frequency drive manufacturers.

Fully-loaded and unloaded V/Hz curves are shown in Figure 1. When a drive with a fully-loaded V/Hz characteristic is applied to an under-loaded motor, the full magnetizing current provided is greater than is required by the load. This over magnetization, as previously mentioned, produces heat in the motor. The solution is to determine what voltage the motor needs for proper operation at a given speed.

The actual adjustment of the V/Hz profile has often been the responsibility of the end-user. This requires the user to define points along the curve in the drive V/Hz profile or use another control algorithm within the drive settings. SCI has realized that unfortunately some of our customers have been choosing a higher V/Hz profile than is necessary. This has resulted in excessive heating of the motor and eventually leaking liquefied grease from the gearbox.

To help its customers reduce over magnetizing the motor and damaging the gearbox, SCI has worked with a number of VFD manufacturers. Please contact us for a list of VFD manufacturers and our suggested parameters for them.

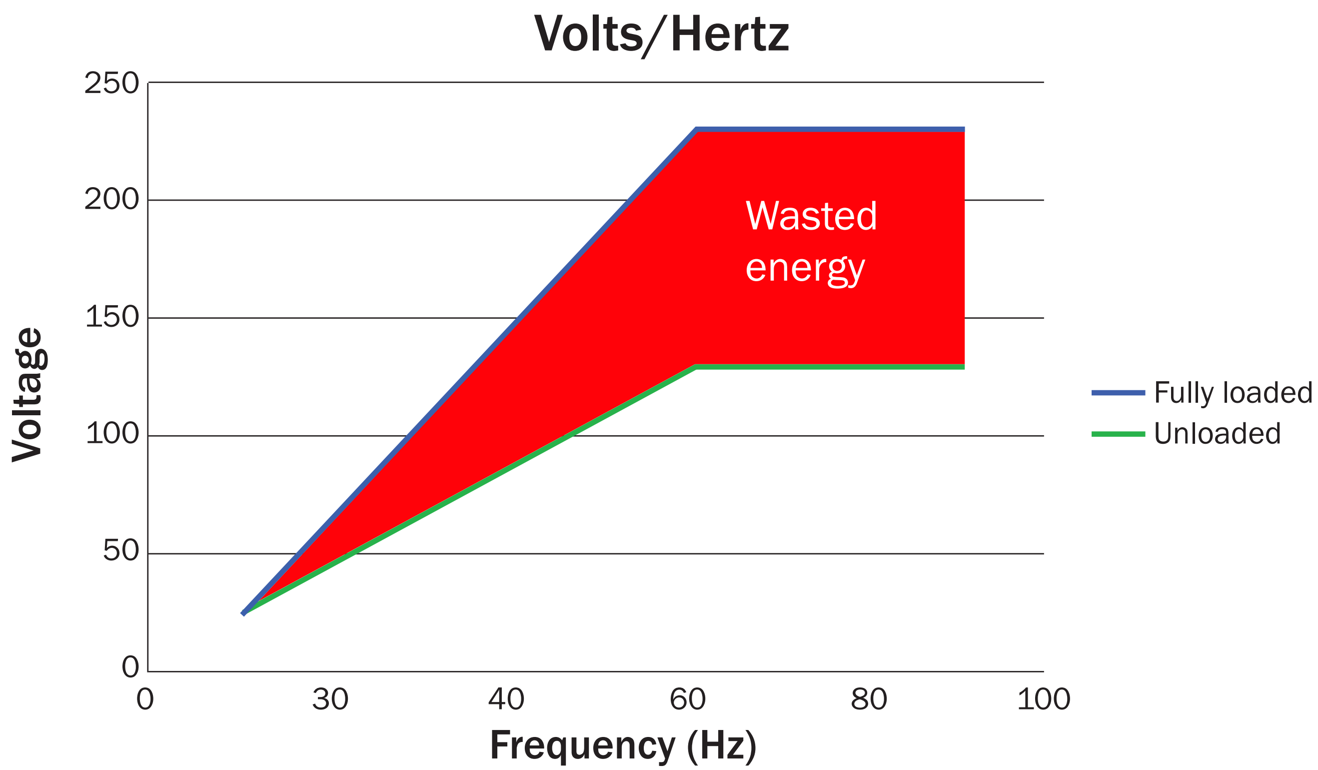

Figure 1: Fully-loaded and unloaded V/Hz curves