MACHINE THROUGHPUT IMPROVEMENT ACHIEVED USING INNOVATIVE CONTROL TECHNIQUE

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Abstract

In any type of fully or semi automatic machine the control systems plays an important role. The control system on the one hand has to consider the human psychology, intelligence requirement for an operator, and attention needed from him. On the other hand the complexity of the control has also to be understood well before designing a control system that can be handled comfortably and safely by the operator. As far as the user experience/comfort is concerned the design of control system GUI is vital. Considering theses two aspects related to the user of the machine it is evident that the control system design is very important because it is has to accommodate the human behaviour and skill sets required/available as well as the capability of the machine under the control of the control system. An intelligently designed control system can enhance the productivity of the machine.

INTRODUCTION

The control system has been developed for subsystems of three different electrical machines. The present works describes how the throughput of a machine can be enhanced by innovative control system design.

SYSTEM OPERATION

Control system for three different types of electrical machines has been designed/ developed and installed. Following is the description of the machine productivity improvement by control system design:

1] Beam utilisation factor improvement from 50% to 98% by modulating the speed of the convey system: A 10MeV, Electron beam, RF Linac is operational at EBC, Kharghar, Navi Mumbai. The beam output scans one meter length in a scan horn. The product under irradiation is placed below the beam horn on a conveyor trolley. The trolley is one meter long and there is one meter gap between each of the trolley. With the highest possible (limited by trolley track conditions and angle of turn since the trolley follows the zigzag path) constant speed of 5mtrs/min operation of the trolleys, the beam utilization by the product kept in trolley will be 50% since same amount of the beam falls in the gap between the trolleys. We have modulated the speed of the trolley. The trolley speed is reduced from 5mtrs. /min to 0.1mtrs/min when it is under the beam otherwise when the beam falls between the trolleys the conveyor speed is kept at 5mtrs. / min. This speed modulation operation is performed by sensing the arrival and departure of the trolley using a limit switch which is activated by the base of the trolley. Using this method the beam utilization for the irradiation goes up to 98% from 50% hence 48% rise in productivity.

2] Productivity improvement of the Electromagnetic machining facility: APPD/BARC has developed a 20kV 10KJ Electromagnetic machining (EMM) facility. In this EMM facility a large value capacitor is charged by a DC supply to a set voltage. This charged capacitor is then quickly discharged using triggered spark gap into a coil to generate an intense magnetic field. This magnetic field generates the eddy current into the job piece to do the mechanical forming. We have developed and installed a PLC based control system to control the EMM machine. We used to charge the capacitor bank manually before the control system was installed. A DC voltage source made using motorised variac was being used for the capacitor charging. When the voltage is set the capacitor takes time equal to five RC times constant by charging the capacitor exponentially to charge to the set input voltage.

With the implementation of PLC based control system in the EMM facility the capacitor voltage has been conditioned /isolated and fed to the PLC. When the operation starts the PLC sets the double voltage as the charging voltage to the capacitor bank and trip voltage as the capacitor voltage desired. When the power is switched ON the capacitor starts charging very fast since the input voltage is two times to that of the desired voltage. As soon as the desired voltage on the capacitor bank is reached the control system isolates the charging supply to the capacitor bank. This technique reduces the total charging time to $1/7^{th}$ to that of the earlier technique. Since the EMM facility is an industrial production machine, the productivity is a direct function of the capacitor charging time. Hence it can be stated that the total throughput of the EMM machine can be enhanced by 700%.

CONCLUSION

The control system has been commissioned and it is working satisfactorily. The capacitor charging time has been reduced but the full utilisation of this reduced time can only be done when the job piece under machining is loaded on the machine using automatic feeding system.

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