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SIMULATION OF TURBINE SYSTEM OF A BAGASSE UNIT FOR POWER EFFICIENCY USING LABVIEW

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ABSTRACT

A bagasse unit generally collects the bagasse that remains after juice is extracted from sugarcane. This bagasse can be used for generation of electricity. The turbine system used in the bagasse unit is mainly used for electricity generation. The better the design of the turbine system, the more is the power efficiency of the electricity produced. Simulation of the turbine system ensures that the design of the system is such that optimal amount of output is generated and the efficiency of the system is maximum. Virtually designing such complex systems makes the removal of faults easier, it consumes less amount of time and is less expensive than the traditional methods. Virtual design of turbine systems reduces the failures occurring during operation and also curbs the amount of losses due to maintenance of unexpected failures.

KEYWORDS

Turbine system, bagasse unit, LabVIEW, power efficiency, simulation.

1. INTRODUCTION

Power generation generally involves turbine systems for generation of electricity. Bagasse units use bagasse as fuel for electricity generation which reduces the dependence on fossil fuels and non-renewable energy resources. Superheated steam flows into the turbine through valves and rotates the blades in the turbine which are connected to the generator for power generation. The valves play an important role here as uncontrolled steam flow will rotate the blades incessantly which will result in failure of the turbine. The efficiency here is the isentropic efficiency which has to be taken care of. This efficiency can be calculated by simulation and accordingly the turbine system can be designed depending upon the fuel and other parameters. The parameters modelled are designed as separate blocks for computational reasons using LabVIEW software package. The most useful feature of such kind of computational model is that, it can be used for all kinds of fuels and parameters. An optimal design of the turbine system will be obtained which will provide maximum efficiency for any given set of parameters (Indian Cane Power Limited; Gupta et al., 2009; Hosseini et al., 2006; Kumar et al., 1995).

2. METHODOLOGY

Figure 1. shows the methodology followed. Generation of power requires a heated steam to flow into the turbine system which can rotate the blades of the turbine. This steam is produced by the boiler system. To develop a turbine system, it is very essential to consider the input parameters of the system which come from the boiler system. After obtaining the values they are wired to the appropriate blocks. The turbine system is mathematically modelled to develop blocks or Virtual Instruments (VI). All the VIs are then interconnected to form the complete turbine system (Kumar et al., 2007).

The formation of the turbine simulation model is followed by validation using computational techniques (Ankur Scientific Technologies). The readings from an actual cogeneration system are obtained. The system is validated with the same set of input parameters as that of the cogeneration system, and if the same output is produced then the system is said to be behaving as the same as that of a real turbine system (Energy Efficiency, 2006). The behaviour of the model should match with the actual model so that optimum parameters can be determined.

Figure 1: Methodology

3. BOILER SYSTEM

Figures 2 and 3 show the block diagram and virtual interface of the turbine system in LabVIEW. The parameters which are analysed are: the steam generated, steam flow, net steam flow, steam pressure, drum pressure and throttle pressure.

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Figure 2: Block diagram of turbine system

Figure 3: VI to view the simulation

The power generated in MW is the output from the turbine system. The efficiency is calculated by computing the ratio of the output produced to the given input (Energy Performance Assessment). A block of correction factor is added to the system which maintains the efficiency of the system by behaving like a feedback loop (Toa et al., 2018).

4. RESULTS

The results indicating the simulated signals are as shown in figures below.

Figure 4: Simulated signals from turbine system

Figure 4 shows the different waveforms obtained after computation. The drum pressure is seen to be fairly constant. As the net steam flow decreases the correction factor increases which is added to bring the throttle pressure to a stable so that the efficiency of the system is maintained. Figure 5 and 6 show the efficiencies without and with the addition of the correction factor. The efficiency range is 60-80% without correction factor and 70-90% with correction factor (Mtunzi et al., 2012).

Figure 5: Efficiency without correction factor

Figure 6: Efficiency with correction factor

5. CONCLUSION

The turbine system model described in this paper can be useful for developing actual turbine systems with any given parameters. The simulation model performs such computations that the efficiency obtained by the system is maximum and constant. This system can also be used for predictive maintenance as the values obtained by the system can be constantly monitored.

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