Discussion of the critical control, process, disturbance, and constraint variables.

If more fuel is used to heat the kiln, the combustion at the hot end of the kiln will consume more oxygen, thus decreasing the amount of excess oxygen in the kiln. Increasing the induced draft fan speed will increase the cold end temperature by drawing air from the hot end of the kiln to the cold end. Drawing cooler air from outside the kiln into the hot end of the kiln will also decrease the hot end temperature. One can also see that by increasing the amount of air drawn from outside the kiln, the amount of excess oxygen will be increased. Similarly, primary air flow will also affect the amount of excess oxygen. The greater the amount of excess oxygen, the lower the TRS emissions, but the cost is higher heat loss.

Heat loss is an important economic variable in the rotating lime kiln process. If more heat is lost, then more fuel will be required to operate the kiln, raising the cost of production. The heat lost by the kiln can be minimized by lowering either or both the amount of excess oxygen and the cold end temperature, subject to minimum excess oxygen constraints.

Two other production variables can have important effects on the exit temperature of the lime. The rotation speed of the kiln affects the total time that the lime mud is in the kiln. The lime mud feed rate obviously affects the amount of lime that must be heated during this time. If there is a greater amount of mud or if mud is going through the kiln at a faster rate, then more fuel will be required to heat the material.

The last variable to consider is the cold end pressure (draft). This is an important constraint variable because it can be used to prevent the formation of an unwanted ring on the inside of the kiln [1]. This ring formation can inhibit the air flow in the kiln, resulting in poor heat transfer from one end of the kiln to the other. To inhibit ring formation, one can decrease the cold end pressure (increase draft) by increasing the induced draft fan speed. Increasing the induced draft fan speed too much, however, can result in more dust recycle, which can hurt production [2].