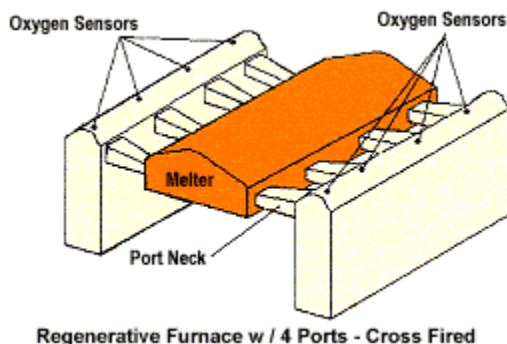


PROBLEM:

In any combustion reaction, theoretically there is a required volume of oxygen to react with a given amount of fuel. Typical combustion systems mix a fuel, such as natural gas or oil, with air. Unfortunately, air contains only 20.9% oxygen. The remaining 79.1% consists of nitrogen and other gases that are not required for combustion. These detract from the combustion process by having to be heated and causing lower efficiency.

A combustion process may be run with high levels of excess air and still melt glass. However, this wasted fuel contributes to pollution and causes quality defects. On the other hand, running at too low a level of excess air will create problems at the other end of the spectrum. Insufficient oxygen causes raw fuel to flow up the stack. This situation creates waste and air pollution, damages the refractory and platinum tank parts, and contributes to quality defects. In most combustion processes, it is safest running with excess oxygen. The level of waste is about twice as high on the fuel rich side of stoichiometric combustion as it is on the fuel lean side. Therefore, it is best to run with slightly excess oxygen to ensure against the possibility of the more wasteful, reducing conditions.



SOLUTION: Measure where it matters!

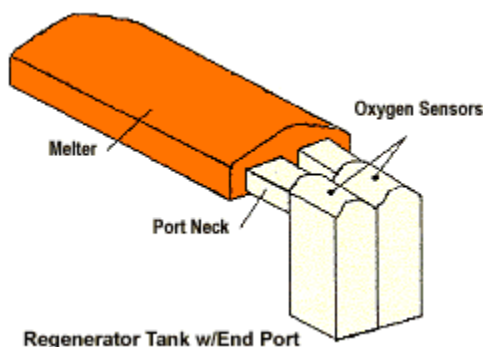
There are two major types of oxygen analyzers found in the glass industry: low temperature, sampling types (extractive) and high temperature in-situ sensors. Both types work in glass melting furnaces, but excessive maintenance limits the usefulness and reliability of the extractive units. Maintenance is required because the high temperatures and batch components combine to produce a very destructive environment for any equipment. Heaters, pumps, sample lines, and cells require continuous attention. Regular calibration

services are a must. The filter system of the pumps must be cleaned periodically due to moisture in the hot gases.

The introduction of the high temperature in-situ oxygen sensor has virtually eliminated these problems. In-situ oxygen sensors do not require pumps, heaters, filter systems, calibration, etc. The sensor must be in the furnace where the combustion is complete. The regenerator crown and high on target walls are locations proven around the world in flat glass tanks. Direct fired tanks with recuperators such as found in fiberglass plants use installations in the crown of the melter, back wall of the melter, or in the recuperator stack (preferred). Proper installation of the sensor will insure its performance.

RESULTS

The cost of sensors is generally very low compared to the operating regenerator tank expense of the glass tank. Fuel savings are established by using a well-accepted rule of thumb from burner manufacturers. Above 1400°C, approximately 1.5 to 2.0% in fuel will be saved for every 1% reduction in excess oxygen. Generally, savings of 1 - 3% in fuel costs can be expected. Continuous excess oxygen measurement will provide a tighter, more responsive air/fuel ratio to be maintained. The result is a more consistent quality product.



Reducing conditions are controlled to preserve the refractory and the platinum tank parts. Air pollution is another big advantage of using sensors. NO_x formation is influenced by exhaust temperature, fuel level, and excess oxygen. Lowering excess oxygen will lead to lower emissions.



Air/fuel systems benefit from oxygen trim control systems, but the utilization of oxygen/fuel systems makes the use of sensors imperative. Air is free. In oxygen/fuel systems, both the fuel and the oxygen are major expenses.

The high temperature oxygen sensor has been established as dependable and simple to use. It is considered a good choice to insure consistent excess oxygen in the glass tank. With the uncertainty of the gas composition being delivered to a facility, it is essential to control the air/fuel ratio to minimize emissions, maximize fuel efficiency, and maintain the standard of quality required by the glass industry.