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Applicationbrief

Eclipse Product: ImmersoJet Burner — IJ-8 v1

Submitted by: Rob Forbes, Eclipse Calgary

Application: Oil Sands Flash Treater

Description: Eclipse was contacted by Universal Industries Corp. (UIC), an operating entity of Foremost Universal LP, in Lloydminster, Alberta, to provide an immersion tube burner system for a new patented design of a flash treater. Universal Industries has been supplying customers with a full line of oil and gas processing equipment since 1949.

The process of evaporation dehydration involves boiling the water out of oil. At atmospheric pressure, water turns to vapour at 100°C (212°F), whereas the oil, except for some light ends, has a higher boiling point. During a conventional heavy oil treating process, free water and the larger droplets of water in the emulsion are removed by application of heat, chemicals and residence time. The remaining emulsion usually contains small droplets of water (up to 10% BS & W).

The UIC/Colt Flash Treater® has been designed to break that remaining emulsion (whether it is a slop feed or the outlet of a conventional treater), which may otherwise be impossible or too expensive to treat. Recovery of this untreatable heavy oil can effectively pay back the UIC/Colt Flash Treater® quickly. The UIC/Colt Flash Treater® recycles hot dry oil from its outlet to the incoming stream of wet oil. This hot oil will cause a majority of the incoming water to vaporize. The recycling of hot oil, the large volume of oil in the vessel and the baffled heating path enable the UIC/Colt Flash Treater® to handle substantial slugs of water and emulsion without foaming and unstable operation.

Overall Side View of Unit Showing Both IJ-8 Burners and Control Cabinets

The IJ-8 Version 1 was the type of burner that would fit the application, but there were some issues to address to ensure safe and reliable operation in the field.

Two important issues are Viscosity and Cracking

1. **Viscosity** - There is a caution in the IJ-8 Installation Guide about highly viscous fluids. We looked at the heavy oil viscosity and found that it is on the borderline of #4 & #5 (light) oil. The Eclipse Engineering Guide shows:

   #4 fuel oil at 35-160 SSU, 0.85-0.99 spec. grav.

   #5 (light) fuel oil is 80-700 SSU, 0.89-1.01 spec. grav.

   The customer's oil is 100 SSU (20 cP), 1.0 spec. grav.

2. **Cracking** - Les Unrau, General Manager of UIC describes the cracking process:

Cracking is a fairly complex process that is affected by temperature, pressure and retention time. An increase in any of these parameters increases the likelihood of cracking. Conversely, a decrease in one means the others have to be increased for cracking to happen. When done as a process, thermal cracking typically takes place at 700°C (1290°F) and 1000 psi. I don't think cracking will occur in our application for the following reasons:

1. Our pressure is very low (3-5 psig)

2. The bath temperature is relatively low at135°C (275°F).

3. Our typical process vessels, using natural draft burners, have retention times in the order of hours, the units that these power burners are going into have retention times of less than 20 minutes.

4. The vessels are large enough and open enough that the hot fluid is not held directly against the fire tubes; it can move away as convective currents and be replaced by new fluid. We further encourage this action by spraying hot oil continuously onto the surface of the tubes through a 2" pipe with jets every foot along each heater tube leg as well as one re-circ pipe along the bottom of the vessel.

End View

Combustion Cabinet Inside

David Collier (V.P. Engineering at Eclipse) advised on the Cracking condition and what methods would avoid it:

The main concern is carbon forming on the outside of the tube due to the "oil cracking". The hottest part of the tube is the end of the combustion chamber and the first section of tube and this is where the oil will crack first. This carbon will form an insulated barrier and cause the high temperature to move down the tube and hence more cracking. If the carbon forms a very effective insulation barrier the tube or combustion chamber will eventually fail.

To minimize the effect I would suggest that you direct the re-circulated oil to flow over the combustion chamber to increase the heat transfer rate and reduce the surface temperature. If 700°C (1290°F) is the cracking temperature, there should be no problem with the ImmersoJet.

With the fluid circulation methods that UIC had provided in the unit to address the heat transfer it was decided to implement a control method to ensure the maximum firing rate is moderated by the heat transfer. Larry Meek (Calgary service technician) suggested a cascaded controller design which was implemented with two Honeywell UDC controllers.

The temperature control system for the treater is designed to operate using two temperature controllers to provide minimum heat up and recovery time while still protecting the immersion tube from exceeding an operating temperature which may lead to carbon formation.

The first temperature controller, labeled as the Operating Temperature Control, senses the product temperature in the vessel. The second temperature controller, labeled as the Stack Temperature Control, senses the flue gas temperature in the burner exhaust stack. The Operating Temperature Control compares the product temperature with the selected Set Point, the output from the Operating Temperature Control is sent to the Stack Temperature Control as the temperature Set Point. This Set Point is designed to operate within a specified set point temperature range. The output from the Stack controller to the burner firing rate valve varies to maintain the varying Stack Set Point. This action will continue until the product temperature inside the vessel meets the Operating Temperature Control Set Point. This ensures a slow, controlled heat-up ramp which will reduce the coking of the immersion tube, that reduces tube life.

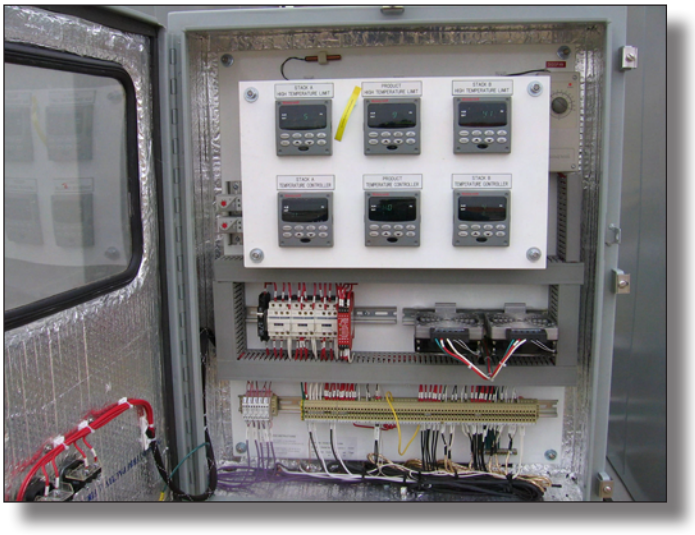
Deer Creek Energy Flash Treater Prototype
UIC has patented this new multi-pass tube oil treater design and plan to take the lead over their competition. Their past history of these treaters has been with Atmospheric Injector burners in tubes up to 30" diameter for a comparable firing rate, UIC currently has thousands of units in the field.

Eclipse Calgary designed and built a single burner IJ-8, V1 system for UIC to supply for a flash treater for Deer Creek Energy. The process vessel has the IJ-8 burner mounted horizontally in a process vessel. This first unit has the control panel, blower and valve train located inside the heated process building which is a Class I, Div. II hazardous area.

Burner firing rate: 5.625 MM Btu/hr
Immersion Tube: 4-pass tube, 29 feet long each leg (4x29=119 ft)
Oil viscosity: 100 SSU (20 cP), spec. grav. 1.0
Incoming fluid temp is 110° – 140° C (230° – 284° F)
Process temp is 135° C (275° F)
Process high limit temp is 150° C (300° F)
Stack controller set point range – -50° C to +260° C (-58° F to +500° F)
Stack high limit temp is 300° C (570° F)

Jacques Inkel (technician Eclipse Montreal) provided start up for the system. Process start-up was done by Larry Meek. The burner was tuned with fluid flow and it produced a smooth, controlled temperature ramp to the setpoint of 140° C (284° F). UIC has 6 temperature probes in the vessel and all read within 7° C (45° F) of each other.

Dual Burner Design
Eclipse Canada supplied two dual burner units since the first prototype. Each system consists of two IJ-8 V1 burners firing at 6.25 MM Btu/hr in the same vessel for a combined firing rate of 12.5 MM Btu/hr. The other specifications are the same as the Deer Creek Energy prototype. All of the installation photos shown were taken at start-up. The cabinets enclosing the blower's valve trains and control panels were designed by Harry Ajamian and fabricated in Montreal. We have positive feedback from the Devon Energy operators on the powerful, reliable operation of this treater; it is their first experience with a power burner in this type of process. The initial process throughput is 80 cubic meters per hour of heavy oil. The second dual unit is due to start later this year.



Temperature Control Panel

Process Pumps

Below is the data from a combustion analysis test performed with an EGA4 on the first dual burner treater unit that was started in February 2007 at the Devon Energy Manatokan site near Bonneyville, northeast of Lloydminster, Alberta.

BURNER A		
COMPONENT	VALUE	UNITS
O2	3.2	%
CO2	9.9	%
CO	1	PPM
Gas Temp.	330.7	° C
Eff. Net	85.5	%
Loss Net	14.5	%
Exc. Air	1.16	

BURNER B		
COMPONENT	VALUE	UNITS
O2	3.4	%
CO2	9.8	%
CO	0	PPM
Gas Temp.	355.9	° C
Eff. Net	84	%
Loss Net	16	%
Exc. Air	1.17	

Cabinet End View

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