

## **SINGLE STAGE CYCLONES IN REACTORS AND REGENERATORS**

Single stage cyclones should be considered for reactors and regenerators that do not have gas fluidized beds but, instead, discharge the gases and catalyst into vessels from openings in the sides of risers or through rough-cut separation devices.



- **Performance** - in a number of units the single stage cyclone performance has significantly exceeded the performance of the two stage cyclones they replaced. This is because gases leak through the second stage dipleg valves, carry catalyst into the diplegs, re-entrain most of the catalyst coming down the diplegs and carry the combined catalysts out of the second stage cyclones.
- **Initial Cost** - a vessel that required 8 sets of two stage cyclones (16 cyclones) would typically require 12 single stage cyclones. The material cost of the single stage cyclones would be about 20% less than the cost of the two stage cyclones, but the installation cost would be about 30% less, because there are only 12 cyclones to install and there is no need for support lugs or support nozzles on the vessel head. When increased through put is the reason for cyclone replacement, a two stage system may require an increase in the vessel height but this would not be required for a single stage cyclone system, an additional cost savings.
- **Maintenance Costs** - The need to inspect 12 cyclones, instead of 16 cyclones, during each turnaround reduces the time required for inspection. Eliminating the high maintenance second stage cyclones eliminates 2/3 or more of the total maintenance required for the cyclone system.

### **Concerns that one considering Single Stage Cyclones may have:**

- **There is no backup for high losses from the single stage cyclones**  
Because erosion in first stage cyclones is minimal, the only causes of significantly higher losses are mechanical failures or blocked diplegs. Either of these will force a unit shutdown, because the second stage diplegs are not large enough to discharge the high additional catalyst loading.
- **There may be high losses during startup due to catalyst deaeration in diplegs**  
This can occur when first or single stage diplegs discharge through trickle valves. When diplegs with Buell 45° counterweighted valves discharge above any bed, this concern is eliminated. Trickle valves operate by pressure, which requires the catalyst to be fluidized. Counterweighted valves operate by weight so deaerated catalyst do not prevent operation of these valves.

### **Single Stage Cyclones in Operation**

For over 20 years, process licensors have specified single stage cyclones in reactors where the catalyst discharged from the risers through downward directed arms or from rough-cut separators. About 10 years ago Buell made the first replacement of a two stage cyclone system with single stage cyclones in a regenerator that did not have a fluidized bed. In this regenerator, the catalyst discharges in a downward direction from arms on the side of a riser. Buell now has five single stage cyclone systems operating in regenerators where the catalyst is discharged from riser arms. Two additional systems are currently being designed.

***Experienced, Innovative, Responsive***

# **Buell**<sup>®</sup>

**REFINERY CYCLONES**

**FISHER-KLOSTERMAN** 

A CECO Environmental Company

200 North Seventh Street, Suite 2  
Lebanon, PA 17046

Deliveries to:  
203 N. 5th Street

Phone: 717.274.7154  
Fax: 717.274.7342  
buell@fkinc.com  
www.buellrefinery.com



CECO Environmental

CECO Environmental Corp.  
3120 Forrer Street  
Cincinnati, OH 45209  
Phone: 513.458.2600  
Fax: 513.458.2647  
Toll Free: 800.333.5475  
cecoenviro@cecoenviro.com  
www.cecoenviro.com  
NASDAQ: CECE

©2008 07/08