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## **NEW DEVELOPMENTS IN FCCU ANCHORING SYSTEMS** **FOR** **THIN ABRASION RESISTANT LININGS**

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With the recent increase in unplanned shutdowns on old Refinery FCCU's and the significant increases in scope of work for hexmesh repairs during planned shutdowns, Refineries have been left with very little options as to repair methods. In the past maintenance teams have had no choice but to accept the lengthy repair times to the abrasion resistant linings in their FCCU's. The time consuming methods of refractory demolition, hexmesh removal and replacement has cost Refineries millions of Dollars in down time!

As a result of the aforementioned, CHB Third Party Refractory Inspectorate, was eager to discover new alternative repair methods for hexmesh linings which were less time consuming and less costly to the client. Unlike with historical materials, CHB have discovered the new generation of ACTCHEM materials –Actchem 45 and Actchem 75- retain their good plasticity after the addition of steel fibres. This characteristic has made single point anchor systems a viable alternative to standard hexmesh systems.

ACTCHEM 45 & 75 has been installed onto single point anchors on Air Grid Elbows and ends of the Arms, Cyclone Inlets, Cyclone Roofs, Riser Lines, Riser Nozzles, Reactor Diplegs and Reactor Stripper Shell. This repair method was adopted where S-bars, Speed Cells or punched corner tabs were unavailable or where repairs / modifications to vibrocast linings in Risers required a superior material to ensure a safe and effective repair. Hence, the repairs listed below resulted in the use of single point Vee anchors, hand welded and alternated 90<sup>0</sup>. For these applications ACTCHEM was mixed as per manufacturer's recommendation, once plasticized, 3 % 304 or 310 stainless steel melt extract fibre was gradually added into the mix. The ACTCHEM was hand placed with the aid of a rubber mallet.

The bulk of these repairs have been in service for over 5 years with no repairs necessary. All follow up inspection were conducted by CHB.

## REGENERATOR CYCLONES

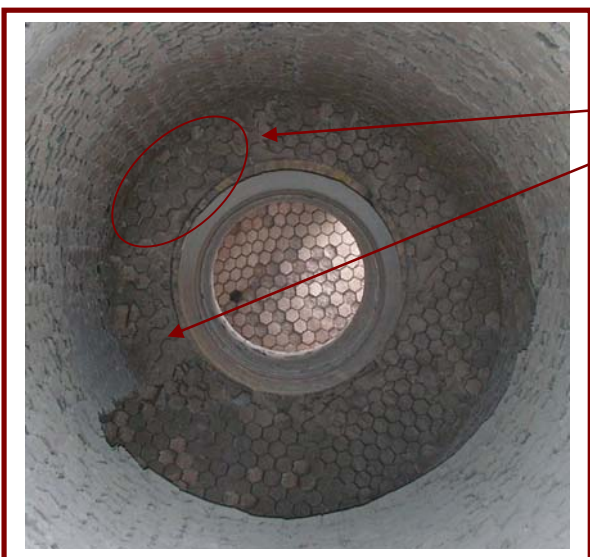
Extensive unplanned repairs to 12 Regenerator Cyclones resulted in an opportunity to use the single point anchor system with ACTCHEM. The radical approach was adopted due to major time constraints, lack of experienced boiler makers for fitting hexmesh as well as insufficient hexmesh, s-bars and punched corner tabs. To further save on repair time the refractory was chipped out and the existing worn hexmesh was left in-situ. Single point Vee anchors, 6mm diameter, 25mm long, 310 s/s, were welded into each hex cell, see fig 01&2.

Although the repairs were undertaken as temporary while the client ordered new Cyclones, CHB were confident that we would achieve a sound homogeneous lining with sufficient anchorage to attain the maximum run duration. The repairs out performed all expectations and lasted the require 4 year cycle to the next shutdown. This saved the refinery millions of Dollars by avoiding un-necessary down time for further patch repairs.

**Fig. 01** Hexmesh on Cyclone Roof after removal of refractory



**Fig. 02 Before** - Hexmesh with addition of single point Vee anchors on Cyclone Roof.



**Fig.03 After** - ACTCHEM still intact on Vee anchors within hex cells after 4 years service.

**Fig. 04** Corner repair area to cyclone inlet after refractory application onto single point anchors



**CYCLONES WERE INSPECTED AFTER 4 YEARS SERVICE WITH NO SIGNS OF WEAR OR ANCHOR FAILURE.**

### **FCCU – Riser Line**

In a modification to an existing steam nozzle in the J-bend of a Riser line, the client opted for the repair to the traditional 100mm thick vibro-cast lining with ACTCHEM 75 (hand pack) with the addition of 3%, 310 s/s fibre. Technically the ACTCHEM 75 had superior properties to the surrounding vibro-cast lining and together with the ease of installing a plasticized material CHB was confident of a sound repair in an otherwise high risk area. The ACTCHEM 75 was hand packed onto 5.5 mm diameter, 304 s/s, wavy Vee, anchors, 100mm length.



**Fig. 05**

Additional anchors were welded in after this photo at the lip of the nozzle inlet. A 2mm ceramic fibre paper was wrapped around the nozzle before hand packing the ACTCHEM 75 with steel fibre around the nozzle.





**Fig. 06  
Post Dry-Out Photograph**

**Repair has been in service for 8 years with no signs of abrasion or spalling.**

**AIR GRIDS**

The same repairs have been conducted on Air Grids Arms and Elbows



**Fig. 07 - S-bar weld failure on Air Grid Arms**



**Fig. 08 ACTCHEM 75 + 3% s/s fibre on Air Grid Elbow**



**Fig. 09**

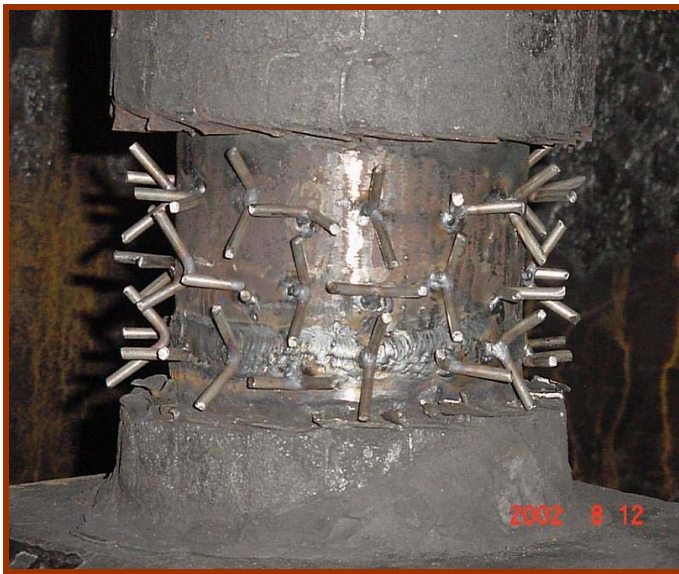
ACTCHEM 45 + 3% s/s fibre on Cat Cooler Air Grid. Single point anchors welded on ends as well as between existing s-bar anchors.

**Inspected after 8 years service:** No signs of abrasion, cracking or spalling. No repairs have been necessary.

### **REACTOR DIPLEGS**

Unplanned modifications to Reactor Trickle Valves resulted in repairs to the abrasion resistant refractory on the diplegs. Actchem 75 was hand packed with 3%, 310 s/s fibre on to single point, 25 mm, V anchors.

**Fig.10**  
**View of Vee Anchors before installation**



**Fig. 11 Completed repair area**







**Fig. 12**  
Dip Leg repairs after being in service for 5 years. Sound lining, no cracking or spalling.

**RISER LIFT POT NOZZLES (Modifications to an existing Riser Nozzle)**

Due to the small diameter and lack of S-bars, single point, 25mm, Vee anchors were hand welded before hand packing Actchem 75 with 3%, 310 s/s fibre.

**Fig. 13 – Nozzle with Vee Anchors**



**Fig. 14 - Complete with ACTCHEM 75**



**REPAIR LASTED THE REQUIRE 4 YEAR CYCLE**

## **REACTOR STRIPPER**

Modification to an Air Ring support.

The refractory was broken out around the support plate. New anchors 85mm, 310 s/s were welded in at approx.100mm centres. Two layers of 2mm ceramic paper were glued to the shell to help reduce heat loss as the ACTCHEM 75 had a slightly higher density than the existing vibrocast material. ACTCHEM was mixed with addition of 3% s/s fibre and hand packed around the support to 100mm thickness.

**Inspected after 5 years service:** No signs of abrasion, cracking or spalling. No repairs necessary.



**Fig. 14** – ACTCHEM (grey material) packed onto single point anchors

## **CONCLUSION**

Due to the success of the aforementioned repairs, further radial approaches to thin abrasion resistant linings on single point anchors are being explored. As a result a French anchor manufacturing company **IRIS** have specifically developed an anchor for this type of application called CH1.RL. For further information on these anchors visit **[www.irisfrance.com](http://www.irisfrance.com)**

Please note CHB recommended all the above repairs only be done with the ACTCHEM range of products. Unlike alternative products on the market ACTCHEM is the only material that retains its good plasticity after the addition of steel fibres, making these types of repairs possible. This method has also been used for packing Riser field joints up to 125mm thick. Traditionally field joints were hand packed with the same vibrocast material using less water, resulting in an inferior joint. ACTCHEM on single point anchors was adopted to ensure the field joint would be superior to the surrounding vibrocast lining. We have experienced no dry-out or commissioning problems and these joints have been in service for over 5 years

These repairs systems are an alternative method available for emergency repairs to abrasion resistant linings in FCCU's. Further consideration must be given to future designs on single point anchor systems as they are proving to out perform all expectations and have resulted in significant savings in Refinery downtime costs.

Compiled By :

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**30<sup>th</sup> March 2009**