

40 YEARS OF PERFORMANCE DESIGNED SOLUTIONS

APPLICATION: IRON FOUNDRY / CUPOLA LOCATION: SOUTHERN USA

## BACKGROUND ❖

Due to a combination of design and refractory selection, a ductile iron pressure pipe shop was experiencing unsatisfactory wear in the cupola spout area. The cupola, melting 16 hours per day at a melt rate of 60 TPH, shows iron taphole and spout temperatures at 2880° to 2900°F. The slag, relatively rich in Al<sub>2</sub>O<sub>3</sub>, MgO and MnO, can be very fluid at these temperatures, accelerating the erosion of the current lining, requiring bottom drops every four weeks.

## UNITED APPROACH ❖

To extend the life of the spout area, the solution required redesign of the lining and a new refractory product.

- **Slag Analysis:** Due to the chemistry of the slag, the maximum liquidus temperature is approximately 2400°F, making the slag very fluid at high temperatures.
- **Lining Analysis:** Heat flow analysis confirms that the UNI-RAM SC-966R/50% Al<sub>2</sub>O<sub>3</sub> castable interface in the original lining is 2345°F. With two thirds of the original hot face at or above 2500°F, the fluid slag penetrated deeply into the hot face and dissolved a significant amount of the refractory. Therefore, the original 50% Al<sub>2</sub>O<sub>3</sub> castable backup provided both too much insulation for the hot face material and too little resistance to the aggressive slag, causing more frequent relines.
- **Lining Redesign:** To increase the temperature gradient across the hot face, while adding increased slag resistance to the lining system, URC proposed a second component of UNI-PUMP 327. With 10.25" of the ultra-low cement, slag resistant pumpable castable, the critical interface was reduced to 2047°F, thereby improving the performance of the UNI-RAM SC-966R to where repair materials were reduced from 3,300# to 1,000# (30,000# reduction annually).

- **Veneer Casting:** Due to both the slag resistance and the pumpability of UNI-PUMP 327, the shop built on the success of the new lining design to increase efficiencies with a technique called veneer casting.

1. Remove slag from worn areas down to clean refractory surface.
2. Position a burn-out wooden form in the spout.
3. Pump UNI-PUMP 327 to form the new hot face. (Product can be poured in relatively hot areas. Residual heat in the spout begins cure-out/dry-out. Complete dry-out finished with torches in traditional fashion.)

The veneer casting approach with UNI-PUMP 327 extended spout life to three weeks between repairs, with total spout replacements reduced from 12 to 8 rebuilds per year resulting in approximately 3.5 less drops per year.

## DELIVERED ❖ VALUE

	ORIGINAL LINING	REDESIGN WITH UNI-PUMP 327
Time Between Bottom Drops	4 weeks	6 weeks
Spout	12 per year	8 per year
Material Savings Annually (#)		56,400(#)
Labor Savings Annually (hr.)		52 hrs
Bottom Drops	13 per year	9.5 per year
Material Savings Annually (#)		118,300(#)
Labor Savings Annually (hr.)		840 hrs
Tearout Equipment Savings (\$)		\$14,800

**TOTAL ANNUAL DELIVERED VALUE TO CUSTOMER \$182,300**

## Summary

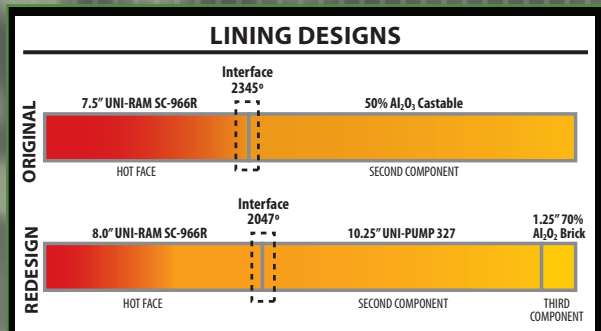
To address the customer's goals of better performance and lower cost, URC analyzed the slag, redesigned the spout area, added an improved product and introduced a new installation technique. All of the improvements resulted in less spout repairs, and most importantly, less bottom drops per year. Not including potential furnace uptime, the total delivered value from URC is approximately \$182,300 of annual savings.



## SLAG CHEMISTRY

	ACTUAL SLAG	TYPICAL PIPE SHOP
CaO	24.55	30.46
SiO <sub>2</sub>	38.55	44.36
Al <sub>2</sub> O <sub>3</sub>	19.69	11.61
MgO	8.10	4.92
FeO	2.62	3.10
MnO	4.92	3.51
TiO <sub>2</sub>	0.62	0.81
Others	0.95	1.27

The slag chemistry was analyzed in regard to specific reaction in the spout area.



The lining redesign focused on lowering the interface temperature and upgrading the second component to maximize wear resistance and performance.



The veneer casting approach increased efficiencies and saved valuable furnace time.

