

# WESU Water Engineering Systems Unlimited

The Scale & Biolife Filter

Economical & Ecologically Friendly Water Systems Specialists

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Furnace cooling in South African smelter.

## R.O.I (Return On Investment) of WESU-SBF ecofriendly water treatment for shell cooling of ~16m dia. submerged arc furnace.

The return on investment calculation below is based on the discussions held with experts in the fields of submerged arc furnaces refractory lining, smelters operators and water treatment experts. Although WESU supplies a complete and turnkey water treatment solution to all the furnace cooling circuits, this study is limited to shell cooling only. All the experts expressed the importance of efficient and scale free cooling water to ensure a long period between revamps. Special thanks to Piet H Lamont, of UCAR®, who enlightened us with his knowledge accumulated over years in the ferrochrome furnace industry in South Africa and abroad without which this article could not have been complete.



Electrode water cooling 2" pipes

While all the figures relating to the cost of the WESU-SBF systems were maximized, the figures relating to the present costs and the cost savings were minimized. Further benefits can be experienced when installing the WESU-SBF-CCWS system on the furnace internal cooling system.



Electrode

Added value, which was not included in these calculations relates to: The significant increase in your company's image from using environmentally friendly processes, which do not use chemicals and do not produce effluent, both being a threat to the environment and the company workforce.

**The results of this R.O.I. calculation are that within 2 months you will get a full return of investment. Sensitivity analysis will result in the minimal period being 2 month and maximum 4 months.**

### Present costs

#	Description of the cost item.	The cost	Annual cost	Annual costs
1	Furnace stoppage to clean scale.	Cumulative 6 hours per annum. 6hr/annum xUS\$60,000/hr x R8.2480/US\$	R2,969,280	\$360,000
2	Chemicals costs for water treatment.	\$5,000/m x12m/annum*R8.2480/US\$	R494,880	\$60,000
3	Energy loss due to scale	0.6mm scale=21% additional energy cost 200kw x8000hr/annum x0.16R/kwh x 21%	R256,000	\$31,000

4	Reduced furnace life due to scale.	Total refurbishing cost of the refractory relines <b>R40,000,000</b> . Furnace life estimated to be 13 years or <b>R3,076,923/year</b> . With scale free water and normal operation furnace life should be 20 year and more. Eliminating scale will prolong the life of the lining by <b>more than</b> one year.	>R3,076,900	\$373,000
<b>Total</b>			<b>&gt;R6,797,060</b>	<b>\$824,000</b>

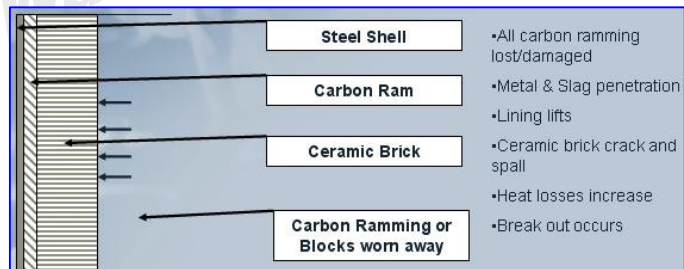
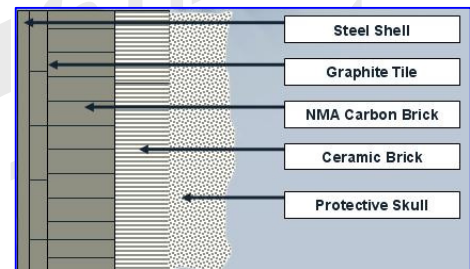
**Operation with the proposed WESU-SBF system;**

#	Description of the cost item.	The cost	Annual cost	Annual Cost
1	Capital cost.	WESU-SBF as per scope of supply.	<b>R888,100</b>	<b>\$107,000</b>
2	Installation costs.	Based on 15% for installation including pump.	<b>R133,200</b>	<b>\$16,100</b>
3	Commissioning	Final design, commissioning and training.	<b>R37,000</b>	<b>\$4,500</b>
3	Electricity	1.2kw x 8,000 hr/annum x 0.16R/kwhr	<b>R1,536</b>	<b>\$200</b>
4	Service costs 1 <sup>st</sup> year	Fitters and electricians for 12 month	<b>R11,400</b>	<b>\$1,400</b>
<b>Total</b>			<b>R1,071,236</b>	<b>\$129,000</b>

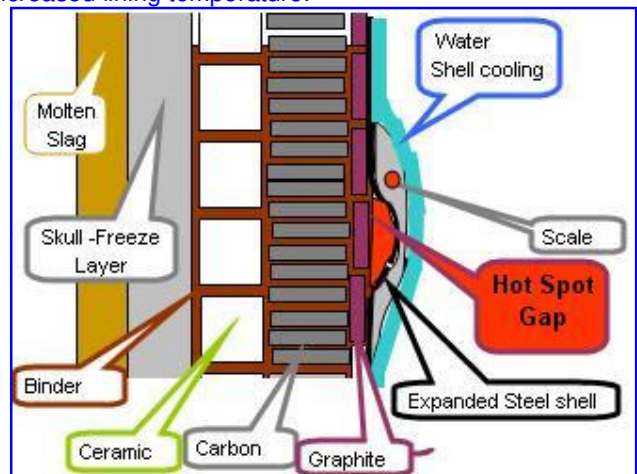
**R.O.I = R1,071,236/R6,797,060\*(12month/annum)= 0.26 years = 1.9 months**

**Discussion:**

- ❖ The life of a submerged arc furnace refractory lining, using skull/freeze layer technology, is anything between 8 and 13 years. Theoretically the life of the furnace may be longer than 20 years, provided that the water cooling systems are working effectively with water free of scale or corrosion, freeze/skull layer technology is used to line the furnace and manufacturer's operation instructions are being followed and long stoppages are reduced to the necessary minimum, all of which will contribute to optimised performance, reduced capital replacement expenditure, reduced relining maintenance and downtime, improved safety and improved profitability. [The picture on the right is showing the consequences of increased lining temperature due to erosion of the skull and chemical/metal attack due to increased lining temperature.](#)



- ❖ This "freeze layer" technology utilizes thinner refractory lining, with all the related advantages such as increase the furnace hearth or, working volume as it is referred to. However, any inhibition of heat flow, such as scale formation on the shell steel structure, will result in increased lining temperature; with it increased abrasion and erosion of the skull followed by erosion of the ceramic brick layer resulting in increased energy loss.
- ❖ Scale formed on the furnace shell will resist the heat flow and increase the



temperature of the shell steel structure resulting in expansion of the steel and separation from the internal lining, which may result in cracks, in the binder and a local increase in the lining temperature which may further be followed by chemical and metal attack of the lining and the lining binding material. The chemical and metal attack will corrode the binder, open finger holes in the binding layers which will allow the molten slag to penetrate into, all the way to the shell casing, causing finger holes in the shell, through which molten slag will flow. This of course will increase the lining temperature in the surrounding area of the finger hole deteriorating and cracking the lining.

- ❖ In some submersible arc furnaces, the scale that builds up on the shell is being mechanically cleaned on a monthly basis. A repetition of scale build up will cause the shell steel sheeting to develop localized cracks in the shell steel.
- ❖ The table below provides information of energy locked by scale or, fouling as it is sometimes referred to, formation on the shell:

\* Data from Carrier Corp.

	<b>Fouling Thickness (mm)</b>	<b>Energy Increase (%)</b>
<ul style="list-style-type: none"> <li>• The total cost of fouling in highly industrialized nations has been projected at <b>0.25% of the GNP!</b></li> <li>• The total annual <b>fouling in the USA</b> has been estimated at over <b>\$18 Million!</b></li> <li>• The total <b>annual cost of fouling</b> specially focused on shell and tube <b>heat exchangers</b> in process industries has been estimated at <b>over \$6 Billion!</b></li> </ul> <p><a href="http://www.fbhx-usa.com/economic_fouling.html">http://www.fbhx-usa.com/economic_fouling.html</a></p>	0,15	5,3
	0,30	10,6
	0,61	21,5
	0,91	32,2
	1,22	43,0

- ❖ “Successful refractory “system lifetime is dependent upon variety of internal and external factors.....the lining configuration and arrangement, **cooling method or lack of cooling obviously**, the wear mechanism encountered in the process.” Chill-Kote” Pieter H Lamont, Emsa, RSA.

**Some photos from a South African chrome smelter where both shell and internal cooling are treated by WESU ecofriendly machines using process water as makeup water to replace river and potable water.**

		
<b>Closed circuit pretreats.</b>	<b>One of 5 cooling towers open circuit.</b>	<b>Process makeup tanks.</b>
		
<b>Cooling tower open circuit</b>	<b>Furnace shed &amp; cooling towers</b>	
		
<b>Extend fill media life.</b>	<b>Extend closed circuit coil pack.</b>	<b>Control scale &amp; corrosion</b>

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