

# FIBRETECH

THE WORLD LEADER  
IN STAINLESS STEEL  
FIBRES FOR THE  
REFRACTORY INDUSTRY

A passport to

50% lower  
refractory costs

REDUCING OPERATING  
AND DOWNTIME COSTS  
BY PROVIDING  
HIGH PERFORMANCE  
LOW COST ALLOYED FIBRES  
TO MEET ALL  
APPLICATION NEEDS

THE  
BEST  
FIBRE

# FIBRETECH

## DELIVERING COST-EFFECTIVE REFRACTORY REINFORCEMENT PROPERTIES WORLDWIDE

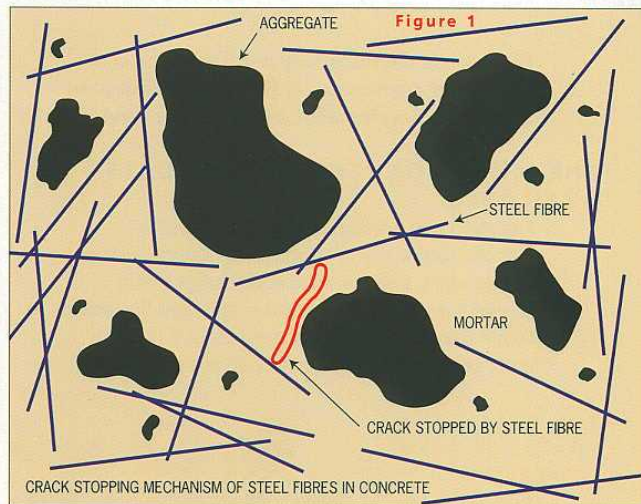
### THE PROBLEM OF MAXIMISING REFRACTORY SERVICE LIFE

Modern high temperature processing industries demand high performance and predictable service from their refractory linings and components.

Whilst developments in monolithic refractory technology over the past 20 years have led to today's generation of low cement, ultra low cement and self flow castables which are resistant to high temperatures, they continue to be weak in tension and offer minimal resistance to damage from sudden changes in stress.

Thermal cycling, thermal shock, mechanical impact or vibration can all cause cracking, which in turn can lead to premature failure and substantial cost penalties.

Achieving maximum refractory service life at a minimum cost is therefore a key element in the efficient operation of these processes, and in enabling companies to maximise their competitive edge.



### THE PROVEN FIBRETECH SOLUTION

For nearly two decades Fibretech has provided the industry with a cure to refractory cracking which has so far produced savings in excess of £200 million. This remarkable cure has been achieved by the inclusion of Fibretech's RS stainless steel fibre to the refractory mix.

The addition of the company's unique Rapidly Solidified (RS) steel fibres to castable, gunning and mouldable refractories inhibits crack formation (1) and transforms the conventional refractory from a brittle material to a tough and tenacious composite (2) exhibiting dramatic improvements in service life. When coupled with Fibretech's unrivalled technical know-how and its knowledge of worldwide industrial applications, we are able to pass on these benefits to all companies seeking to reduce manufacturing and operating costs.

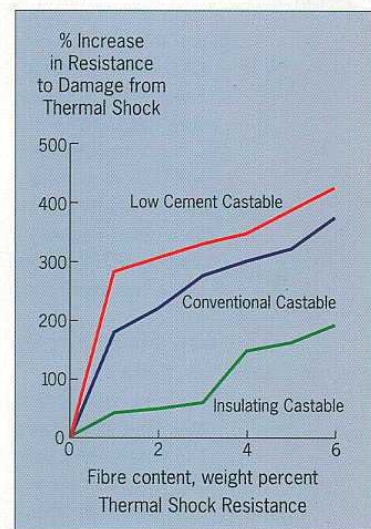
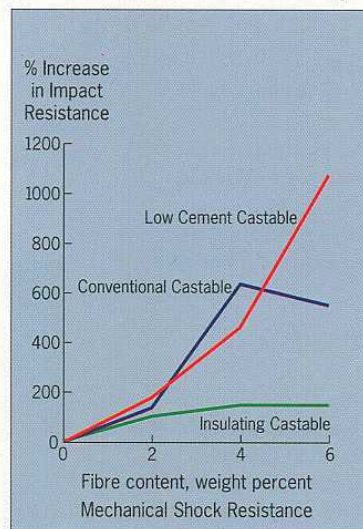


Figure 2

### THE FIBRETECH SUCCESS

Fibretech has an unrivalled track record and has pioneered the use of steel fibre reinforced refractories in industrial applications throughout Western Europe, Africa and Australia. These efforts have been recognised in the many awards the company has received, including "The Queen's Award for Export Achievement".

Through its dedicated sales force, experienced engineering department and trained distributor network, new customers are now benefiting from Fibretech's expertise and advanced products throughout the industrialised world.

## THE FIBRETECH PACKAGE

Despite the best efforts of other companies to match our technically superior and lower cost product, none have come close to matching the unique package of benefits provided by Fibretech.

The Fibretech benefits include:-

- **Dramatic savings in refractory operating costs and downtime.**
- **A specialised range of tailor-made, low cost stainless steel alloyed fibres to meet all applications.**
- **Advanced RS manufacturing technology that ensures superior high temperature fibre performance and corrosion resistance.**



- **The lowest available fibre costs.**
- **Optimised fibre geometry guaranteeing rapid fibre dispersion, ease of mixing and placement and maximised in-service performance.**
- **Specialised packaging designed to minimise handling costs and to meet specific customer requirements.**
- **An established reputation for providing first class service and products to the international refractory producing and using industries.**
- **The first RS stainless fibre manufacturer accredited to ISO 9000.**
- **Unrivalled in-depth knowledge of steel fibre technology and economic refractory fibre applications.**

# FIBRETECH

## FIBRETECH - THE BEST CHOICE FOR THE REFRACTORY INDUSTRY

Fibretech is the refractory industry's No.1 supplier of stainless steel fibre and is dedicated to product development and customer service.

### THE MOST CONVENIENT PRODUCTS AVAILABLE

Fibretech has worked closely with refractory manufacturers and contractors to develop a range of packaging and a unique fibre design which guarantees ease of fibre addition and rapid dispersion within the mix. Fibretech's products are now the most convenient to use of any on the market.

### THE IDEAL FIBRE SHAPE FOR EASY DISPERSION

Experience has proven that ease of dispersion and maximum in-service performance of RS fibres is optimised with a Fibre Aspect Ratio = 50 (Aspect Ratio is defined as fibre length/fibre diameter). Other 'smoother' fibre types only achieve optimum reinforcing at larger aspect ratios due to their inferior bonding properties. As a result these high Aspect Ratio Fibres give poor fibre dispersion, fibre balling and reduce the workability of the refractory mix.

### ALIGNED FIBRE PACKAGING MINIMISES MIXING TIMES...

Fibretech now offers its range of 400 series stainless steel fibres in pre-aligned fibre packages. The fibres are uniaxially aligned in specially designed cartons prior to shipment. When opened the fibres flow freely out of the carton, considerably reducing the time it takes to add the fibre to the mix.

### ... AND REDUCES HANDLING COSTS

Since the volume of the aligned package is more than 50% smaller than that of a conventional carton substantial savings are also achievable in freight costs and warehousing space. Fibretech is the first company in Europe to offer its stainless steel fibre customers this significant benefit. In those instances where fibres are to be removed from the package by hand, such as in pre-weighing, the directional alignment also makes this significantly easier, quicker and safer (3)

Rapid  
Dispersion  
from  
50%  
smaller pack



Aligned Fibre Package

# FIBRETECH

## THE BEST CHOICE FOR CASTING AND GUNNING

Fibretech's direct spun stainless fibres are fully annealed and therefore are more pliable and ductile. This is of particular benefit during the mixing cycle and when the refractory composite is installed.

### EASY MIXING

These pliable fibres are not only more user friendly than the stiff 'needle-like' cut fibres, but also have better flow characteristics. Dispersion is further aided by the optimum Aspect Ratio design guaranteeing rapid fibre separation during the mixing phase. Pre-weighed fibres can be added en masse to most types of refractory mixer and full dispersion accomplished in just 1 minute!

### EASY GUNNING

The ability to install fibre reinforced refractory mixes by gunning is an important consideration in today's modern refractory industry. Melt extracted fibres are specified as a mandatory requirement by most international petrochemical companies where fibre containing mixes are routinely gunned inside large processing vessels and ductwork. During gunning annealed RS fibres readily pass through the equipment with minimal additional wear.

Cold drawn wire fibres can cause real problems. The 'stiff, inflexible' fibres often bridge the ports and orifices in the gunning machine, with resulting blockages leading to expensive delays and wasted materials. Wire fibres are also prone to penetrate rubber components and so generate excessive wear on seal plates, hoses and nozzles.



Cement Kiln - Chain Section, South Africa

### 50% LESS REBOUND LOSS

Fibretech's RS fibre also has a major influence on the cost of the sprayed linings. On impact with a sprayed surface the majority of ductile fibres contained within a mix stay in place, whereas a high proportion of the stiff drawn wire fibres rebound resulting in a very expensive waste material. Rebound loss of RS fibres is typically 50% less than that of drawn wire fibres.

### PERFECT REFRACTORY/ FIBRE BOND

The rough cast surface texture and irregular profile of Fibretech RS guarantees 'mechanical interlock' with the refractory matrix (4)

The unique 'kidney shaped cross-section' (5) provides a higher specific surface area for bonding than round or flat fibres and is free of surface lubricants which are often present

on chopped wire and slit sheet fibre and which prevents bonding. (Whereas cut fibres are sometime supplied with hooks on their ends in an attempt to increase anchorage these deformations add to the weight of each fibre and typically reduce the number of 'effective fibres' per Kg by a significant 10-15%).

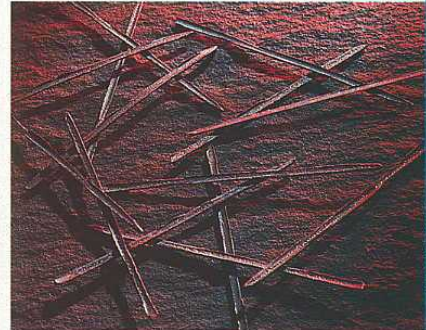


Figure 4

Irregular surface contour of Fibretech RS Fibre

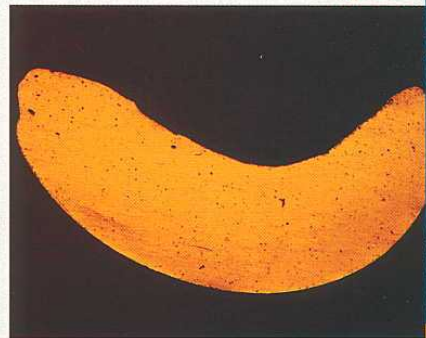


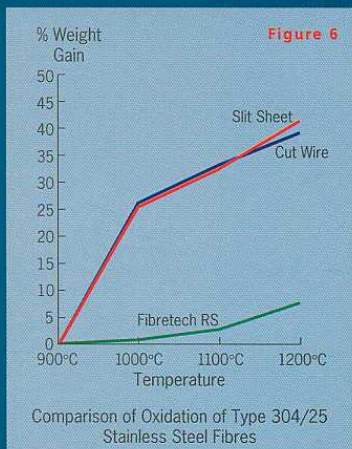
Figure 5

High specific surface area of Fibretech RS Fibre

10-15%  
superior  
bonding

## SUPERIOR RESISTANCE TO HIGH TEMPERATURE CORROSION

Fibretech RS stainless steel fibres are spun directly from the melt using the company's advanced Melt Extraction (ME) and Melt Overflow (MO) processes. Rapid cooling of the fibre during manufacture (equivalent to 50,000°C per second) 'freezes' the metallurgical structure, capturing it in an optimum state to resist high temperature corrosion - a state which is impossible for conventionally cast steel to match. The RS processing maximises the effective distribution of the primary nickel and/or chromium alloying elements throughout the fibre whilst simultaneously minimising grain size. When coupled with Fibretech's skill of blending non-standard levels of performance-enhancing key trace elements to the melt, a unique range of dedicated refractory fibre alloys have been produced which provide outstanding oxidation resistance and unmatched performance at temperature (6).



Other types of steel fibre are produced by cutting or machining conventionally cast and rolled stainless feed material, often from scrap or reject materials. Apart from not possessing Fibretech's RS characteristics, which are crucial in obtaining

maximum performance from the constituent alloys, their high temperature properties are compromised by the need to allow for other processing activities of the raw material such as cold working or welding.

Figure 8

COMBUSTION ATMOSPHERE	Relative Corrosion Rates for Fibretech Standard Alloys*					
	ME430	ME304	ME446	ME310	ME330	
Oxidation (Cycling to 980°C)	Poor	Poor	1	3	5	
Carburization	980°C	Poor	Poor	3	1	4
	1095°C	3	3	2	2	1
Sulphur	570°C	4	2	1	2	-
	815°C	2	4	1	1	-
	1095°C	Poor	25	1	2	24
Sulphur and Carburization	815°C	3	4	1	2	-
Nitriding	980°C	17	16	1	2	-
	540°C	15	10	19	4	1
Reducing	-	3	2	1	1	Poor
Hydrogen	540°C	1	1	1	1	-
	760°C	3	1	15	1	-
Hydrogen Sulphide	540°C	2	2	1	1	Poor

\*Fibre with corrosion rate of '1' is the best alloy for the environment shown.

Figure 7

ALLOY		Fibretech Standard RS Alloys				
		FIBRETECH ME430	FIBRETECH ME304	FIBRETECH ME446	FIBRETECH ME310	FIBRETECH ME330
Primary Element	Chromium	14-18	18-20	23-27	24-26	17-19
Composition %	Nickel	0	8-12	0	19-22	34-36
Melting Temperature °C		1480/1530	1400/1455	1425/1510	1400/1455	1345/1425
Recommended maximum service temperature °C	Cyclic heating	850	870	1205	1040	1050
	Continuous service	815	980	1100	1150	1165
Coef of Thermal Expansion x 10 <sup>-6</sup> @ 870°C Per °C		13.7	20.2	13.1	18.5	17.6

Depending on the degree of thermal gradient in the refractory lining fibres are used in applications up to and exceeding 1650°C eg. injection lancer.

## THE BEST FIBRE CHOICE FOR EVERY APPLICATION

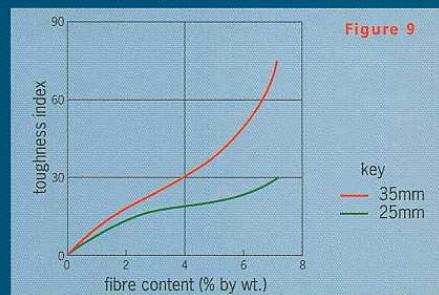
It is essential to select the correct fibre length and fibre alloy for each application. No other company provides a wider choice of alloy composition and fibre size than Fibretech.

### FIBRE ALLOY

As Fibretech produces its own high quality steels, we have developed a range of alloys (7) to cope with the full diversity of service temperatures, operating conditions, combustion gases, etc (8). When coupled with the benefits of RS processing, Fibretech's alloys provide outstanding high temperature durability and substantially outperform other so called 'equivalent' fibre types on the market with similar Cr and Ni additions.

### FIBRE SIZE

Our 25mm long fibre is a popular choice for addition to preblended dry refractory castables and gunning mixes. For on-site mixing and for precast shapes our 35mm fibre is a preferred choice imparting even greater performance benefits for the same cost (9). For special applications 6, 12, 20 and 50 mm fibres are also available, as are other non-standard sizes.



## CONSISTENT AND PREDICTABLE STRENGTH AT ALL TEMPERATURES

Whereas the tensile strength and modulus of all types of steel fibre diminishes with increasing temperature, Fibretech RS fibres are substantially more stable than cut wire fibres. When wire fibres are exposed to modest refractory temperatures above 700°C the fibre's tensile strength is dramatically reduced due to annealing. This results in a marked drop in the load carrying capacity of the fibre. However, Fibretech RS fibre does not suffer this rapid drop in tensile strength at temperature. Mechanical reinforcement is therefore more predictable and reliable than with other fibre types.

## FIBRE COSTS UP TO 50% LOWER THAN COMPARABLE PRODUCTS

Cost savings are the main reason for adding stainless steel fibres as, in **all** areas of high thermal and mechanical shock, fibres will at least double refractory life.

Fibretech's low cost - high performance RS fibres provide the quickest payback. Our quality product costs substantially less because we produce our molten steel and spun fibre on-line in one fully integrated manufacturing plant. When the benefits of streamlined production are combined with the economic savings of 'direct spinning', Fibretech is able to keep fibre manufacturing costs to a minimum. These low production costs are reflected in the very competitive prices Fibretech charges - **in most instances 50% lower than other fibre suppliers.**

## FIBRE ADDITION RATES

It is essential to include sufficient fibre in the mix to prevent the microcracks which develop under thermal stress from propagating into visible cracks which lead to premature refractory failure.

International experience has proven that the most cost-effective fibre addition for enhanced serviceability, **irrespective** of fibre type used, is 1% by volume (this is equivalent to 3-4% by weight for most non-insulating refractory mixes).

In an endeavour to trim initial costs, a few refractory suppliers have been tempted to use fibre contents as low as 2% by weight. This is contrary to the current trend towards the use of higher fibre dosage levels (up to 6% by weight) to maximise service life (See figure 2). Manufacturers of expensive drawn stainless wire fibres often promote 2% fibre addition in an effort to present their product as 'competitive'. This approach is in reality a false economy, since the associated reduced service life of the composite makes the low fibre containing refractories work out significantly more costly over their shorter service life.

Attempts to support the argument for 'low fibre addition' by simple laboratory tests of strength and toughness are misleading and do not reflect 'real life conditions'.

100%  
longer life  
50%  
lower costs

## TOTAL QUALITY AT EVERY STAGE

Fibretech is the first and only company in the world accredited to **ISO 9000** for fibre production using Melt Extraction and Melt Overflow. Our manufacturing standards dovetail exactly into the requirements of ASTM A820/90 ensuring consistent high quality.

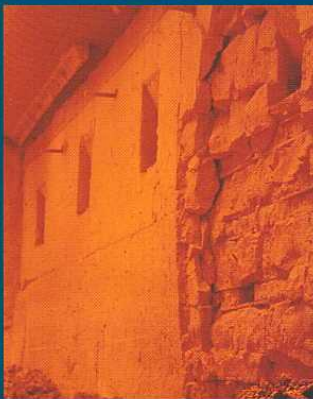
## FIBRETECH - UNRIVALLED SERVICE

Fibretech understands refractory users need immediate product availability to minimise delays in repairs and downtime costs. Fibretech's range is therefore available **ex-stock** for prompt delivery worldwide. Supported by its international network of local distributors built up over 20 years, Fibretech has developed an unrivalled reputation for service and delivery.

Fibretech's distributors are available to offer a unique advice service on how to get the best results from fibres in refractories. Put simply, no other manufacturer can match Fibretech's service or in-depth knowledge of the market.

3-6%  
Fibre Addition

INDUSTRY	RECOMMENDED ALLOY	APPLICATIONS
Iron	446	Blast furnace – tuyeres and goosenecks. Blast furnace runner – security and wear linings, covers linings, syphon box, weirs and dams. Torpedo ladles – throat and cover. Desulphurisation lances.
	430	Blast furnace upper stack. Blast furnace casthouse floor. Torpedo ladle apron.
Steel	446	BOS plant – stack, heat shield doors. Electric arc furnace – deltas, launders, furnace doors. Steel ladles – SIFCA lip segments, security and wear linings, impact pads, purge plugs and nozzles, seating and well blocks, ladle covers. Ladle refining plant – delta section, ladle roof lining, ladle lip, RHOB diplegs, soffit lining. Continuous casting plant – tundish security linings, tundish covers, nozzles, impact pads, baffle walls, refractory shrouds.
	430	BOS plant – fume collecting hood, Ladle transfer car.
Power Generation	446/430	Ash hopper walls, boiler tube skirts and top dead spaces.
Petroleum Refining	310/304/446	Riser, reactor, regenerator, transfer lines, burner blocks, furnaces, flare stacks, orifice chamber, cat. cooler, cyclones, co-generation boiler.
Cement, Lime and Bauxite Kilns	446/310	Preheat zones, lifter blocks, nose rings, planetary coolers, chain sections, burner pipes, dams.
Non-ferrous	446	Doors, doorjams, sills, roof to reveratory furnaces, skimmer blocks, door seals, lintels, carbon baking oven end-walls and capping blocks.
Incinerators	310/330	Combustion chamber walls, roof. Hearth for rotary/multi-hearth furnaces.
Brick & Tile	446	Kiln car deck and edgings.
All Industries	Polypore	Rapid Fire castables.



Ash hopper wall power station (USA) - fibre reinforced refractory on the left lasted 3 times longer.



Mobil Oil Company Ltd - Coryton Refinery, UK FCCU Turnaround 1996. Fibretech fibres used in Regenerator, Third Stage Separator, Flue Gas Line and Transfer Lines refractories



Steel refining by injection lance - refractory reinforced with Fibretech stainless steel fibres.

# FIBRETECH®

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Fibretech fibres are available locally from:

