

# SF SERIES – Reducing the Tin dependency in Friction Materials

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# We offer top-notch solutions for specific needs

Our wide range of additives, specially developed for friction materials, enhance the performance at high temperatures on non asbestos formulations, including Copper-free.

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**Titanates and zirconium oxide**



**Chips and fibers**

**Synthetic metal sulfides**

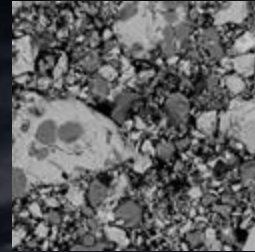
**Synergistic composites for copper replacement**

**Abrasives and friction modifiers**

**Synergistic composites for  $Sb_2S_3$  replacement**

# The challenge of high temperature has an answer in the use of advanced synthetic sulfides

We are able to produce a wide range of synthetic sulfides composites, free of heavy metals and ensuring a stable composition without impurities. Our R & D effort is directed not only to provide counter-types, but to create innovative products with OE quality and the best value-for-money.



SF  
SERIE

Synthetic metal sulfides



SF serie react with the oxygen thus **protecting sensitive components** in the formulations, like resine and graphite.

Sulfides contributes to keep the **integrity of the PAD**, stabilizing the friction coefficient and reducing wear at high temperatures



COST EFFECTIVE

By decreasing the dependence on Tin Sulfide, SF serie breaks the relation LME-cost improving the **cost-effective ratio**.

Our portfolio is based in synthetic Tin Sulfide and Iron Sulfide products, allowing to **find the right cost to performance solution**.

# SF SERIES – A new alternative to Tin Sulfide products

For those with experience in the use of tin sulfide based additives, they will find in the SF serie a product with improved cost-to-performance ratio with the same performance.

SF series (SnS+X·FeS composites) are lower cost and less LME dependent alternatives to traditional tin sulfide based products.

SF05 is recommended to replace SnS based compounds. SF10 and SF13 are recommended to replace SnS<sub>2</sub>. The lower content on tin make them suitable even for High End AM applications.

FE10 is pure synthetic FeS and SN06 is pure synthetic SnS.

**SnS**

79 % Sn

**SnS<sub>2</sub>**

52 % Sn

**SF05**

SnS + FeS  
50%Sn

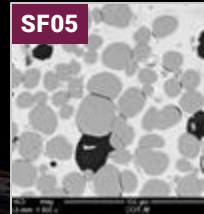
**SF10**

SnS + 2·FeS  
36%Sn

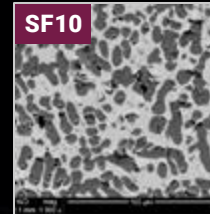
**SF13**

SnS + 3·FeS  
29%Sn

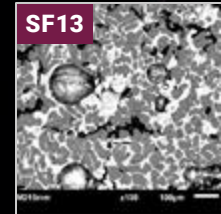
**SF05**



**SF10**



**SF13**



**SF05**



+ 75 %

**SF10**



+ 60 %

**SF13**

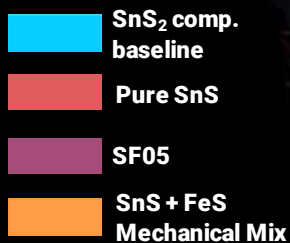


+ 54 %

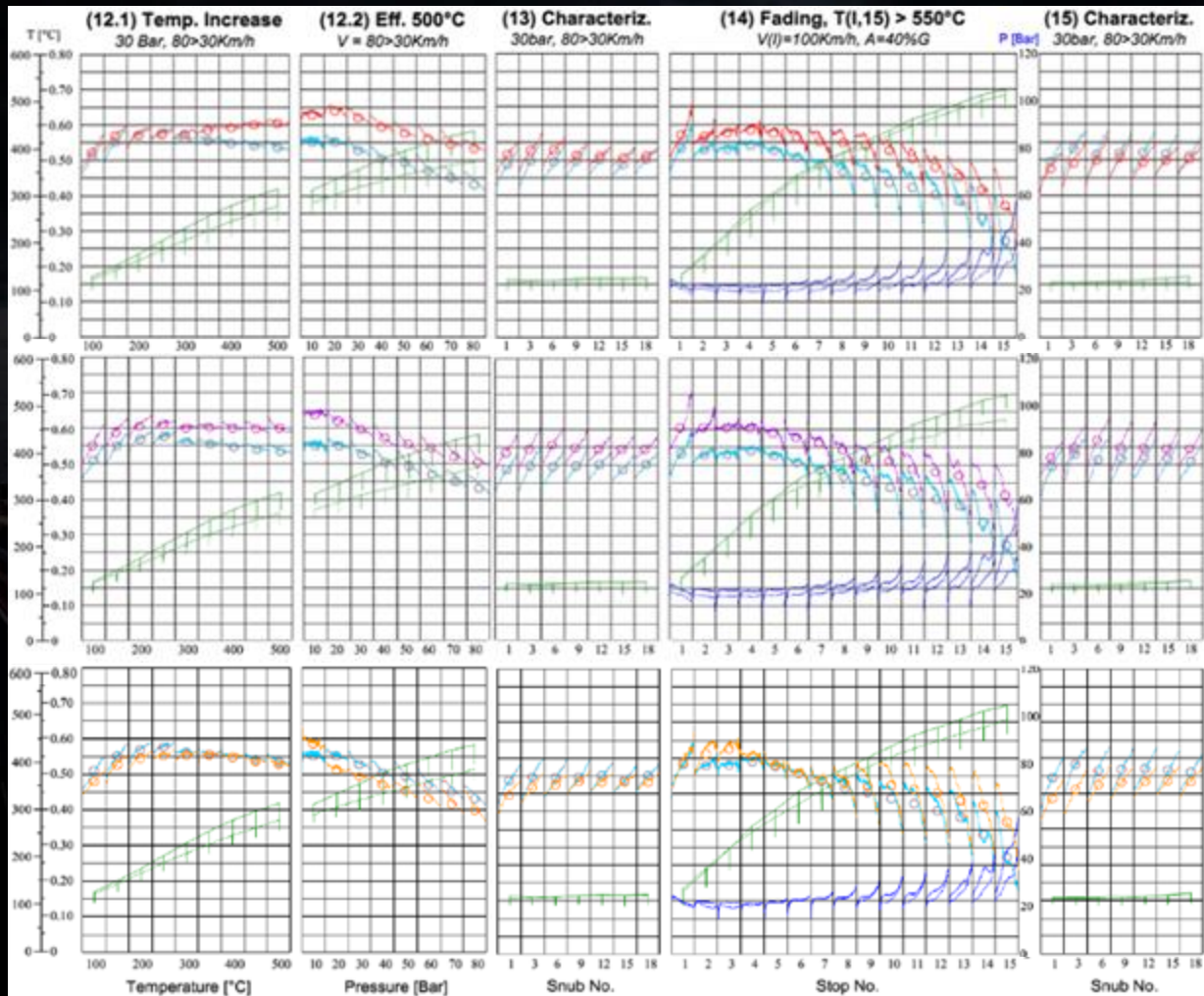
**COST SAVING COMPARED WITH SnS**

# Comparing performance

SF05 improves high temperature and fading performance when compared with SnS<sub>2</sub> composite, being very close to the one of pure SnS.



Test were performed under SAE J2522 in a Passenger Car Copper-free NAO formulation with a content of 5% vol. of sulfide additives

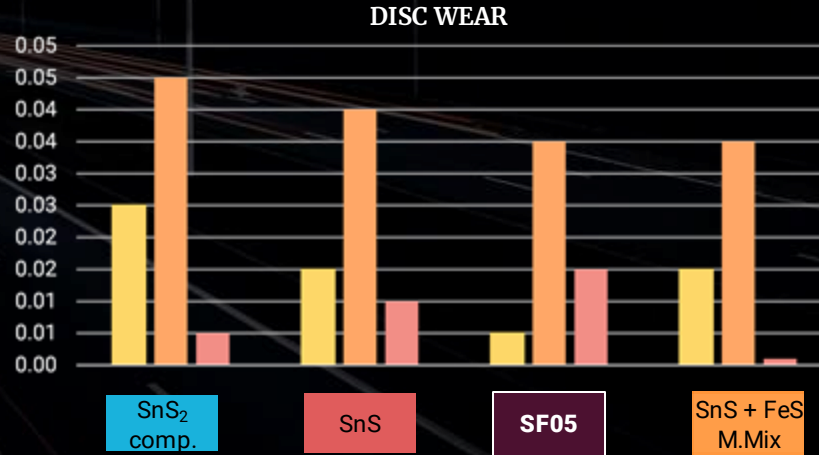
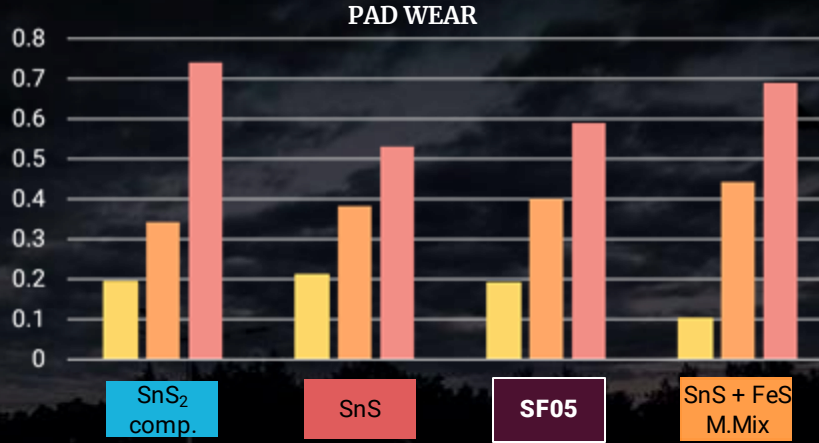


# Comparing wear

The wear with SF05 is very close to the one of pure SnS, considering that the percentage of Tin is reduced from 79% to only 50%.

SF05 is not a simple MIX of FeS and SnS. This can be seen in the results of the PAD wear that show differences when using the SF05 and the MIX of FeS and SnS in the same proportion.

Test were performed under Step Wear Test in a Passenger Car Copper-free NAO formulation with a content of 5% vol. of sulfide additives



# SF05

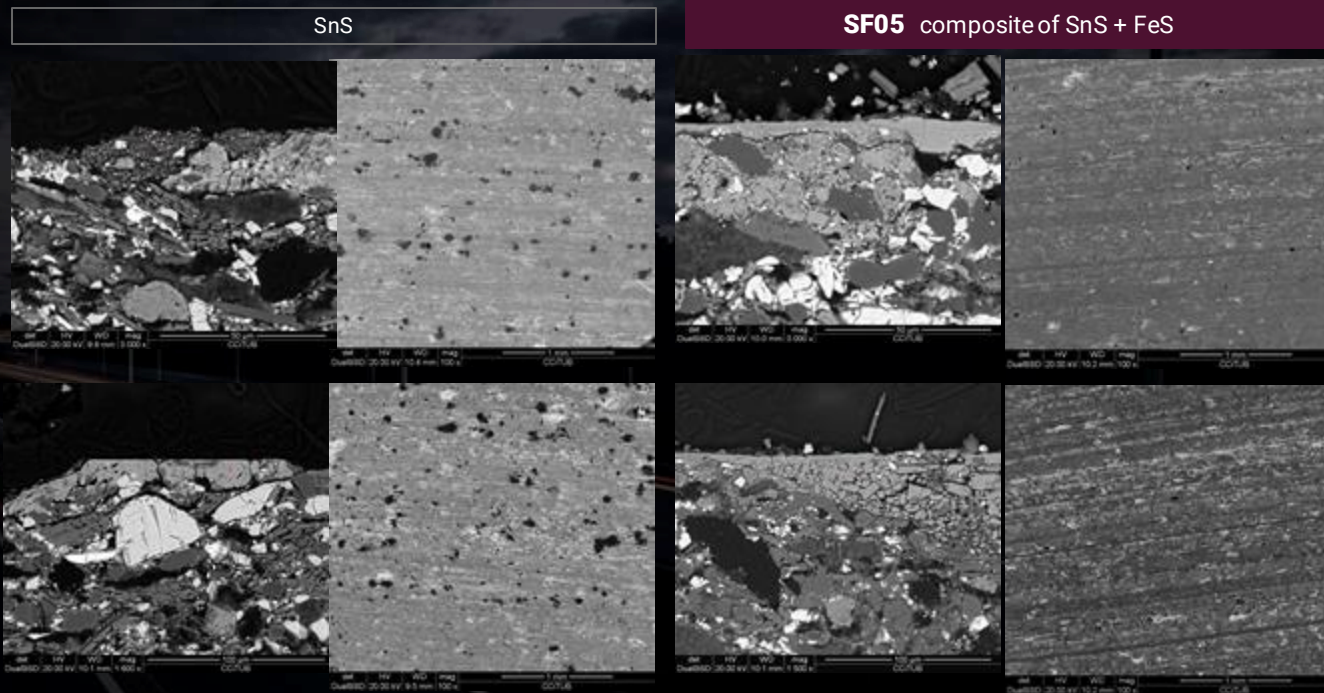
SnS + FeS  
50%Sn

SAE J2522

## Same performance, same tribochemistry

The addition of sulfide improves the continuity of the transfer layer obtained in the rotor after the AKM test.

Being close in oxidation temperature range, the tribochemistry in the rotor obtained with the composite is close to the one obtained with the pure Tin Sulfide, while affected by the harder Iron oxide formed.



# SF05

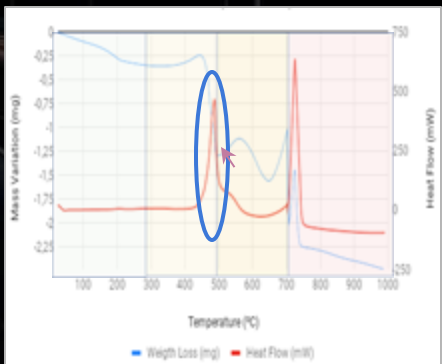
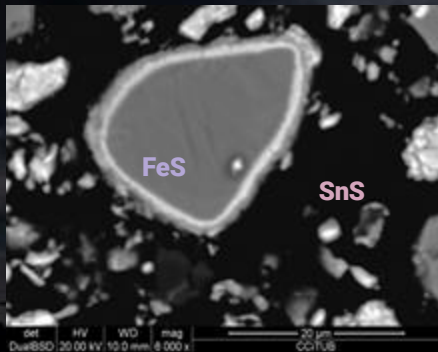
SnS + FeS  
50%Sn

## Why not just mechanical mix?

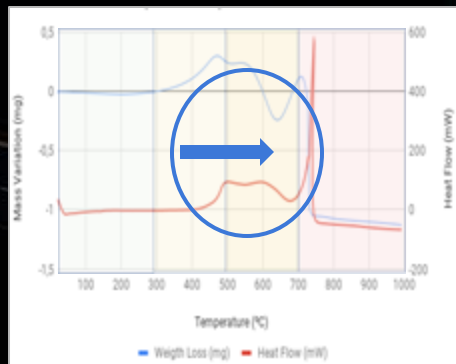
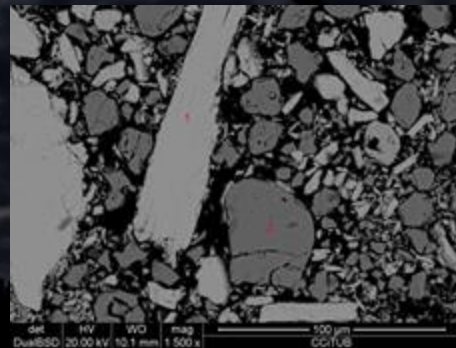
SF serie match the oxidation range of tin based products.

The components SF05 (FeS and SnS) oxidised interfering each other. Resulting in a oxidation curve that is unique and close to the one of pure SnS.

### SF05 composite of SnS + FeS



### Mechanical Mix of SnS + FeS



<300°C
300-500°C
500-700°C
>700°C





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