TESTS WITH FUEL OIL WITH A HIGH CONTENT IN VANADIUM (210-250 ppm) IN ENGINES AT THE MINERA DE SANTA MARTA (M.S.M.) POWER PLANT

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1 - INTRODUCTION

The effectiveness of the additive for fuel oil **"rb bertomeu" beco F1/ASF** in preventing corrosion at high temperatures on exhaust valves and on turbo-compressors of Diesel engines, has been adequately demonstrated in Spain throughout the last years in numerous engines of power plants that use Heavy Fuel Oil No. 1 and Heavy Fuel Oil No. 1 BIA with a highly variable content in Vanadium, ranging from 30 ppm to 130 ppm, and averaging 60-80 ppm.

The additive **"rb bertomeu" beco F1/ASF** is formulated to neutralize corrosion at high temperatures caused by vanadates, no matter the proportion of Vanadium present in the heavy fuel oil and crude oil, we can adjust que required dose of additive.

At the power plant of **Minera de Santa Marta** (Burgos, Spain) we had the opportunity to test the performance of our additive **"rb bertomeu" beco F1/ASF** using a type of **fuel oil with an average content in vanadium of 235 ppm, with a maximum value of 250 ppm**, over a period of four months, coinciding with a change in the type of fuel oil consumed, from Fuel Oil No. 1 BIA to Fuel Oil No. 1. During this period of approximately four months, a type of fuel oil No. 1 with a high content in vanadium (up to 250 ppm) was used. Subsequently, the fuel oil used reverted to one with a lower content in vanadium, within the more usual range of 30-130 ppm.

This test was carried out by the company **Minera de Santa Marta**, during 4 months, in the 3 DEUTZ MWM engines, model BV 16M 640, producing 6.3 MWhe each one, which are installed in the power plant.

Notes:

1.- The dose used during the test, 0.5 litres of **"rb bertomeu" beco F1/ASF** per MT of HFO is equivalent in magnesium content to 0.4 liters of **"rb bertomeu" beco Mg** per MT of HFO.

2.- The **"rb bertomeu " beco F1/ASF** has the same chemical composition as the **"rb bertomeu" beco Mg** plus **dispersants**, demulsifiers, detergents and surfactants. Thanks to the solubility of the magnesium molecules we can provide it all in one single product, while others have to provide the same benefits in two separate products.

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2 – ANALISYS (AVERAGE) OF THE TYPES OF HEAVY FUEL OIL USED

Relevant data on the types of fuel oil used BEFORE, **DURING** and AFTER the test (average data for periods of 4-6 months):

	BEFORE the test	**DURING the test**	AFTER the test
Density at 15ºC	0.962	**0.984**	0.970
Viscosity at 100ºC (cSt)	24.46	**24.70**	23.8
Sulphur %	0.97	**2.32**	2.15
Carbonaceous Residue %	12.3	**17.6**	9.5
Asphaltenes %	3.4	**9.7**	3.6
Vanadium ppm average	**48**	**235**	**63**
Vanadium ppm range	**30-55**	**210-250**	**45-80**

It may be observed that the content in Vanadium of the heavy fuel oil used during the test was 4-5 times above the normal level, both before and after the test, which in theory should have significantly increased the level of blowouts and corrosion on the exhaust valves, during the four months of the test.

The additive treatment of the fuel oil was of **"rb bertomeu" beco F1/ASF**.

3 – HOURS OF TEST IN EACH ENGINE

The use of the fuel oil with a high content in Vanadium began in early April 1998 and ended in early August 1998.

When the tests began, the engine valves had reached between 21,500 and 23,500 hours in operation. The valves were still the original components that had been slightly rectified and reinstalled after each TBO of 3,000 hours (with exception of a very few replacements that had been made), thereby doubling their operational life, estimated at 12,000 hours by the manufacturer. The treatment of the fuel oil with **"rb bertomeu" beco F1/ASF**, almost since the plant was started into operation, made possible this situation and could work against the test, because the valves were nearer to the end of their operational life.

The general overhauls of the three engines, performed before, during and after the test, allow us to calculate with greater precision the actual hours during which each engine was running on fuel oil with a high content in Vanadium.

GENERAL OVERHAULS **BEFORE** THE TEST:

Engine	Date of Overhaul	Hours	TBO (hours)
No. 1	11-Nov-97	21,610	3,581
No. 2	09-Mar-98	23,529	4,309
No. 3	07-Nov-97	21,498	1,768

GENERAL OVERHAULS **DURING** THE TEST:

Engine	Date of Overhaul	Hours	TBO (hours)
No. 1	04-May-98	25,512	3,902 (3,052 with BIA fuel) (**1,850** with fuel high in Vanadium)
No. 2	15-May-98	25,012	1,483 (433 with BIA fuel) (**1,050** with fuel high in Vanadium)
No. 3	28-May-98	26,074	4,576 (3,226 with BIA fuel) (**1,350** with fuel high in Vanadium)

GENERAL OVERHAUL **AFTER** THE TEST:

Engine	Date of Overhaul	Hours	TBO (hours)
No. 1	29-Sep-98	28,713	3,201 (**1,961** with fuel high in Vanadium) (1,240 with fuel No. 1)
No. 2	05-Oct-98	28,059	3,047 (**1,747** with fuel high in Vanadium) (1,300 with fuel No. 1)
No. 3	13-Oct-98	28,902	2,828 (**1,468** with fuel high in Vanadium) (1,360 with fuel No. 1)

TOTAL HOURS operating on fuel oil high in Vanadium

Engine	Total Number of Hours	
No. 1	850 + 1,961 =	**2,811 Hours**
No. 2	1,050 + 1,747 =	**2,797 Hours**
No. 3	1,350 + 1,468 =	**2,818 Hours**

It may be observed that each one of the engines was running on fuel oil with a high content in Vanadium for some 2,800 hours, which is almost one normal TBO of 3,000 hours (around 93% of the TBO).

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4 – EVALUATION OF THE RESULTS OF THE TEST

Quantity of residues accumulated on exhaust valves:

Mid-term overhaul before the test, using Fuel Oil BIA:	1.6 g / valve
Mid-term overhaul during the test using Fuel Oil High in Vanadium:	3.5 g / valve
Mid-term overhaul after the trail using Fuel Oil No. 1:	2.2 g / valve

Conclusion: It was possible to observe an increase in the residue accumulated on exhaust valves, in comparison with the levels produced when using Fuel Oil BIA and subsequently Fuel Oil No. 1. This increase did not cause any problems whatsoever, given that, although the relative increase is high, the level of residues as an absolute value remained low.

Exhaust valve blowouts during the TBOs coinciding with the test:

Engine No. 1:	None
Engine No. 2:	None
Engine No. 3:	None

Conclusion: The increase in vanadium in the fuel oil did not cause valve blowouts, which indicates that the protection of the additive remained effective even with the presence of 225-250 ppm of Vanadium. Blowouts had not occurred in TBOs prior to the test either.

Exhaust valves with the beginnings of a blowout, or with severe corrosion, at overhaul, in Engine No. 1 + Engine No. 2 + Engine No. 3 (96 valves installed in total):

Total at overhaul prior to the test, using Fuel BIA: On 3 valves
0 hours using fuel high in Vanadium for all 3 engines
(Exhaust valves enduring 21,500 – 23,500 hours in operation)

Total at overhaul performed during the test, using fuel high in Vanadium: On 3 valves
3,250 hours using fuel high in Vanadium for all 3 engines
(Exhaust valves enduring 25,000 – 26,000 hours in operation)

Total at overhaul following the test, using Fuel No. 1: On 4 valves
5,176 hours using fuel high in Vanadium for all 3 engines
(Exhaust valves enduring 28,000 – 29,000 hours in operation)

Conclusion: There was no significant increase in the quantity of valves showing the beginnings of blowouts or severe corrosion, in spite of the higher content in Vanadium and the high number of operation hours reached by the valves of all three engines: the operational life of the valves (established at 12,000 hours) was more than doubled. This also indicates that the additive provides effective anticorrosion protection.