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Comparative Microstructural study of Inconel 625 used to turbochargers.

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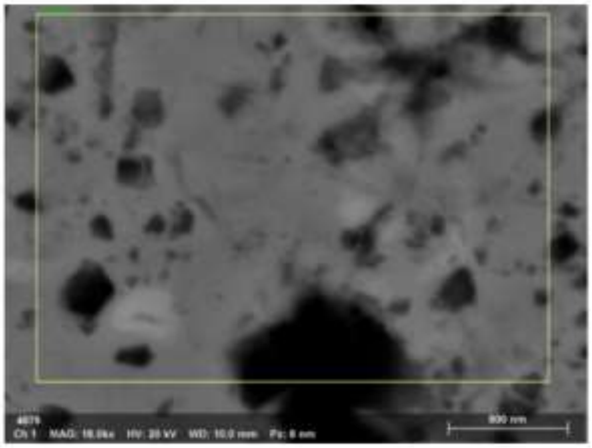
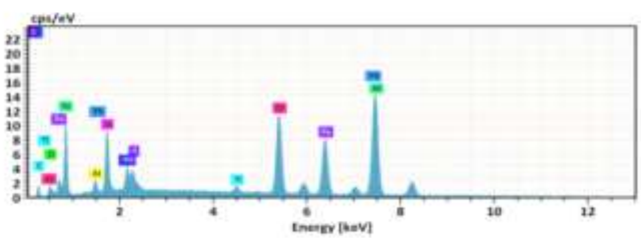
Inconel 625 alloy is a nickel-based superalloy that is widely used in important engineering applications, such as in the manufacture of specific parts for the turbine engines of some automobiles and aircraft [1]. These applications are due in part, to the fact that Inconel 625 resists temperatures ranging from cryogenic to temperatures approaching 1200°C [2], because of its matrix remaining austenitic (face-centered cubic structure which is the predominant phase in Ni base alloys) [3], from solidification to absolute zero, and its weld consumables which offer some properties in the weld state that no other family of superalloys can offer [4]. We present a comparative analysis of a piece of Inconel 625 obtained from the cutting of an automotive turbocharger blade, exposed to high temperatures, is presented. The comparative analysis was investigated by optical emission spectroscopy (OES), scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy, (EDS). Inconel 625 presented an inhomogeneous microstructure, being a key factor causing the intergranular cracking mode of parts exposed to elevated temperatures Figure 1, [4]. In addition, the presence by deposition of rare earth ytterbium (Yb) at the grain boundary was discovered, possibly originating from exposure to elevated temperatures generated by the turbocharger in use [5]. The Inconel 625 chemical composition quantitatively under standard was performed with the use of optical emission spectroscopy (OES) using Worldwide Analytical Systems AG (WAS) software. It is well known that OES is more accurate and has better accuracy and detection limits than SEM-EDS and is a fundamental yardstick in electrochemical [6]. However, for our work both techniques helped us to observe and it agrees the composition chemical Table 1 and Table 2. We observed the presence of the main elements of the composition of the Inconel 625 alloy, such as nickel, chromium, and iron. The results obtained in this study by SEM-EDS are very comparable with those obtained by OES; being both techniques reliable and comparative for chemical composition analysis.



Element	At. No.	Line s.	Netto	Mass [%]	Mass Norm. [%]	Atom [%]	abs. error [%] (1 sigma)	abs. error [%] (2 sigma)	abs. error [%] (3 sigma)	rel. [%]
Nickel	28	K-Serie	76211	38.12	33.13	26.53	1.05	2.10	3.14	
Ytterbium	70	L-Serie	26433	20.15	17.51	4.76	0.58	1.16	1.74	
Iron	26	K-Serie	46272	16.46	14.31	12.04	0.47	0.94	1.41	
Chromium	24	K-Serie	60698	16.35	14.21	12.84	0.47	0.94	1.41	
Carbon	6	K-Serie	3382	7.20	6.26	24.50	1.24	2.48	3.72	
Niobium	41	L-Serie	18218	6.50	5.65	2.86	0.27	0.54	0.81	
Silicon	14	K-Serie	25383	6.10	5.31	8.88	0.29	0.58	0.87	
Oxygen	8	K-Serie	2200	1.85	1.60	4.71	0.37	0.73	1.10	
Aluminium	13	K-Serie	4218	1.38	1.20	2.08	0.10	0.20	0.29	
Titanium	22	K-Serie	3721	0.94	0.82	0.80	0.06	0.11	0.17	
			Sum	115.05	100.00	100.00				

Figure 1. Figure 1. SEM analysis of the Inconel 625 piece presenting inhomogeneous microstructure and EDS analysis, where the presence of rare earth Ytterbium is observed, due to exposure to high temperatures of the turbine.



Nombre de la muestra	Fe	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu	Nb	Ti	V	W	Pb	B	Ca
C	10.0	0.302	1.1	0.32	0.0366	0.0255	26.1	>11.0	>60.0	>1.30	0.103	0.0272	0.112	0.744	0.0867	0.507	<0.0500	-	-

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Figure 2. Figure 2. EDS spectrum of the Inconel 625 specimen and Chemical composition of the sample determined by OES. The composition is the result of the average of 9 "burns" distributed in three different locations of each sample.

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