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OUTGASSING TEST OF CIBAS FERRITE MAGNETS

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	<p>Cibas ferrite magnets</p>	<p>Doc: VIR-TRE-PIS-3400-139 code Issue: 1 Date: 16/01/1999 Page: 2</p>
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CHANGE RECORD

<i>Issue/Rev</i>	<i>Date</i>	<i>Section affected</i>	<i>Reason/ remarks</i>

<p>Authors: M. Bernardini H. B. Pan R. Poggiani</p>	<p>Date</p>	<p>Signature <i>Rse Poggiani</i></p>
<p>Approved by:</p>		


 <p>The logo for VIRGO, featuring a stylized circular symbol composed of several curved lines above the word "VIRGO" in a bold, sans-serif font.</p>	Cibas ferrite magnets	Doc: VIR-TRE-PIS-3400-139 code Issue: 1 Date: 16/01/1999 Page: 3
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In this note we briefly report the outgassing measurement of ferrite magnets from CIBAS. The measurement method is described in detail in VACPISA 025.

1 - System performances

The typical base pressure of the test chamber after a baking at 250 °C for several days is $\sim 10^{-10}$ mbar, with an outgassing rate of the order of $\sim 10^{-12}$ mbar l s⁻¹ cm⁻².

The main components of outgassing after baking are H₂, H₂O, N₂/CO, CO₂. The internal surface of the chamber is 3200 cm².

2 - Measurement of the outgassing rate of ferrite magnets

The experimental samples were six annular loudspeaker style Y30 ferrite magnets by CIBAS; the dimensions were external diameter 7 cm, internal diameter 4 cm, thickness 1.3 cm. The magnets have been preliminarily baked for 18 hours at 120 °C in air.

We monitored the evolution of outgassing (time is measured from beginning of the test through the whole paper):

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
7.8	25	3.2x10 ⁻⁵	2.4x10 ⁻⁷	6.3x10 ⁻⁴
30	30	5.3x10 ⁻⁵	2.1x10 ⁻⁷	1.1x10 ⁻³
103	25	5.7x10 ⁻⁵	1.8x10 ⁻⁷	1.1x10 ⁻³
125	28	6.0x10 ⁻⁵	1.5x10 ⁻⁷	1.2x10 ⁻³

A mass spectrum measured during pumping down at room temperature is shown in Fig. 1.

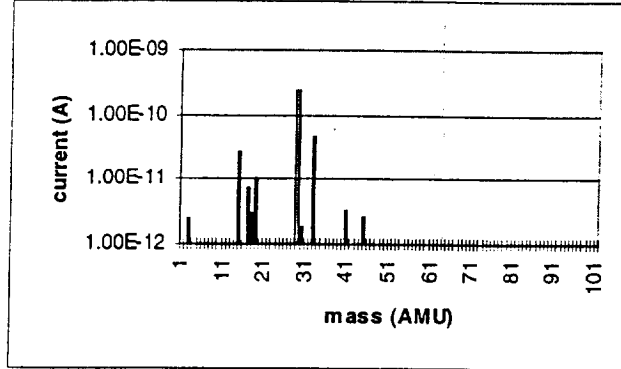


Fig. 1 Outgassing spectrum during pumping at room temperature

We set temperature at 50 °C for 144 hours and monitored the evolution of outgassing:

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
125.5	50	4.8x10 ⁻⁵	1.0x10 ⁻⁷	9.6x10 ⁻⁴
125.8	50	1.3x10 ⁻⁴	6.1x10 ⁻⁸	2.6x10 ⁻³
126.3	50	2.0x10 ⁻⁴	6.7x10 ⁻⁸	4.0x10 ⁻³
126.6	50	2.5x10 ⁻⁴	7.3x10 ⁻⁸	5.0x10 ⁻³
127.5	50	2.1x10 ⁻⁴	8.9x10 ⁻⁸	4.2x10 ⁻³
127.8	50	2.0x10 ⁻⁴	8.7x10 ⁻⁸	4.0x10 ⁻³
194.3	50	9.0x10 ⁻⁶	2.7x10 ⁻⁸	1.8x10 ⁻⁴
195	50	1.8x10 ⁻⁵	3.4x10 ⁻⁸	3.6x10 ⁻⁴
269.7	50	2.7x10 ⁻⁵	2.0x10 ⁻⁸	5.4x10 ⁻⁴

The mass spectra measured at beginning and after several tens hours of heating at 50 °C are shown in Fig. 2 and Fig. 3.

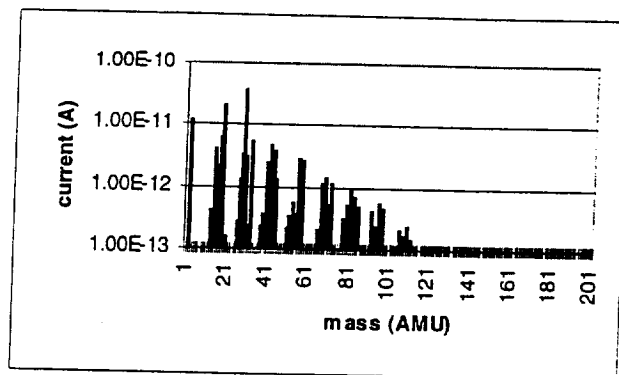


Fig. 2 Outgassing spectrum at beginning of heating at 50 °C

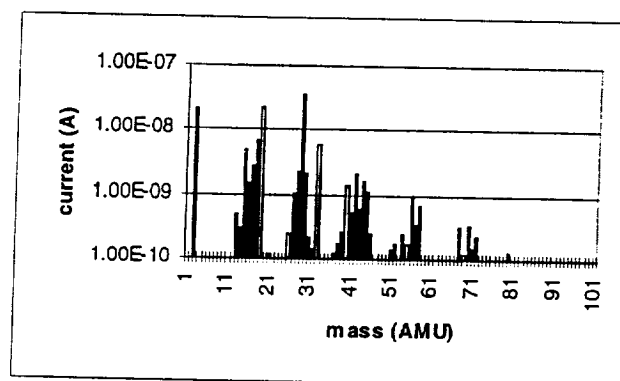


Fig. 3 Outgassing spectrum after several tens hours at 50 °C

Some clusters centered at masses multiple of 14 AMU appeared (typical of organic contamination) and were still present after several tens hours.

We set temperature at 100 °C for 192 hours and monitored the evolution of outgassing:

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
269.8	100	4.0x10 ⁻⁵	2.8x10 ⁻⁸	8.0x10 ⁻⁴
270	100	3.3x10 ⁻⁴	1.5x10 ⁻⁷	6.6x10 ⁻³
295.2	100	2.5x10 ⁻⁵	2.9x10 ⁻⁷	4.9x10 ⁻⁴
318.5	100	1.2x10 ⁻⁷	4.3x10 ⁻⁸	1.5x10 ⁻⁶
341.5	100	1.1x10 ⁻⁷	3.3x10 ⁻⁸	1.5x10 ⁻⁶
342.2	100	1.4x10 ⁻⁷	4.2x10 ⁻⁸	2.0x10 ⁻⁶
365.2	100	7.9x10 ⁻⁸	2.2x10 ⁻⁸	1.1x10 ⁻⁶

461.5 100 1.3×10^{-8} 3.8×10^{-9} 1.8×10^{-7}

The mass spectra measured at beginning and after several tens hours of heating at 100 °C are shown in Fig. 4 and Fig. 5.

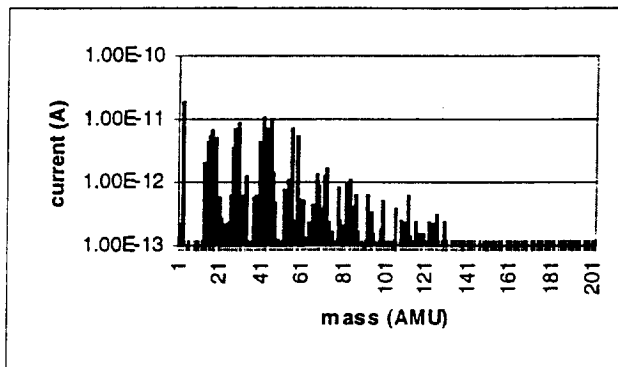


Fig. 4 Outgassing spectrum at beginning of heating at 100 °C

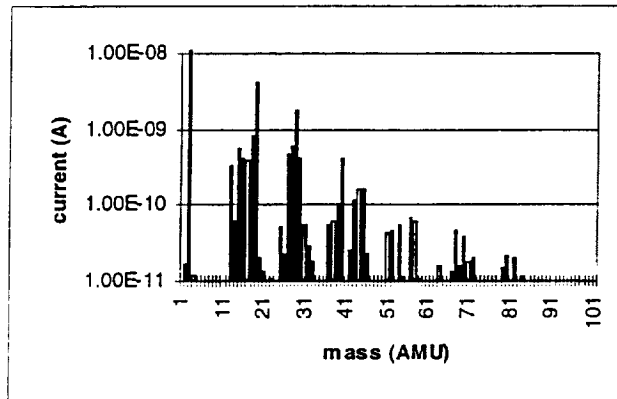


Fig. 5 Outgassing spectrum after several tens hours at 100 °C

The pattern is similar to the pattern at 50 °C, but some higher mass fragments are also present.

We set temperature at 150 °C for 308 hours and monitored the evolution of outgassing:

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
461.8	109	3.8×10^{-8}	1.1×10^{-8}	5.4×10^{-7}
462	120	1.2×10^{-7}	3.6×10^{-8}	1.7×10^{-6}
462.2	135	7.1×10^{-7}	2.0×10^{-7}	1.0×10^{-5}



462.4	143	1.1×10^{-6}	3.3×10^{-7}	1.5×10^{-5}
462.6	144	2.4×10^{-6}	6.8×10^{-7}	3.4×10^{-5}
462.8	147	5.4×10^{-6}	1.5×10^{-6}	7.8×10^{-5}
463	150	7.2×10^{-6}	1.9×10^{-6}	1.1×10^{-4}
510.5	145	1.0×10^{-6}	2.7×10^{-7}	1.5×10^{-5}
701.8	140	2.5×10^{-7}	8.8×10^{-9}	4.8×10^{-6}
769.8	150	5.9×10^{-8}	3.0×10^{-8}	5.8×10^{-7}

The mass spectra measured at beginning and after several tens hours of heating at 150 °C are shown in Fig. 6 and Fig. 7.

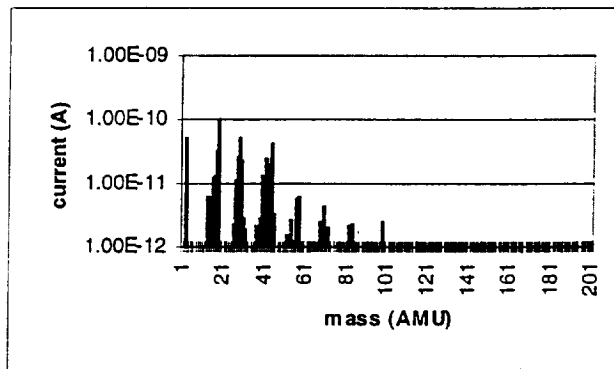


Fig. 6 Outgassing spectrum at beginning of heating at 150 °C

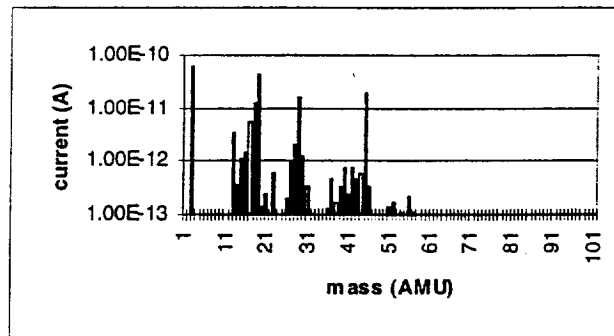


Fig. 7 Outgassing spectrum after several tens hours at 150 °C

Some organic fragments are still present.

We switched off the heating and we measured:



t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
770	120	5.4x10 ⁻⁸	2.8x10 ⁻⁸	5.2x10 ⁻⁷

The mass spectrum after the thermal cycle is shown in Fig. 8.

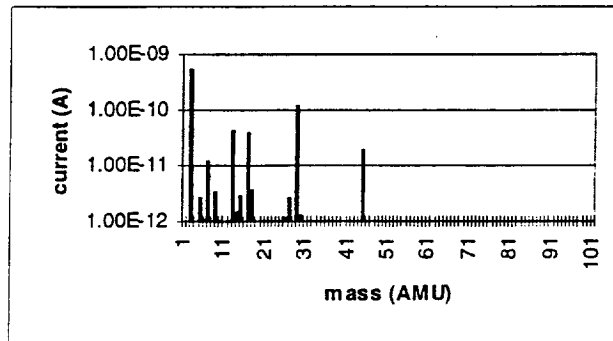


Fig. 8 Outgassing spectrum after the first thermal cycle

Since organic contamination appeared at every step in temperature, we checked if the thermal cycle had been effective to remove it. We heated the samples at 150 °C for 217 hours:

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
942	50	5.6x10 ⁻¹⁰	2.1x10 ⁻¹⁰	7.0x10 ⁻⁹
942.8	150	2.1x10 ⁻⁸	4.8x10 ⁻⁹	3.2x10 ⁻⁷
943.4	150	1.4x10 ⁻⁸	3.7x10 ⁻⁹	2.1x10 ⁻⁷
991.5	150	3.6x10 ⁻⁹	2.2x10 ⁻⁹	2.8x10 ⁻⁸
1007.7	150	1.2x10 ⁻⁹	7.5x10 ⁻¹⁰	9.0x10 ⁻⁹
1032.2	150	1.1x10 ⁻⁹	7.2x10 ⁻¹⁰	7.6x10 ⁻⁹
1110.5	150	1.2x10 ⁻⁹	7.2x10 ⁻¹⁰	9.6x10 ⁻⁹
1129.8	150	1.2x10 ⁻⁹	7.3x10 ⁻¹⁰	9.4x10 ⁻⁹
1135.8	150	1.1x10 ⁻⁹	7.0x10 ⁻¹⁰	8.0x10 ⁻⁹
1158.9	150	1.1x10 ⁻⁹	6.9x10 ⁻¹⁰	8.2x10 ⁻⁹

A spectrum measured during the second heating at 150 °C is shown in Fig. 9.

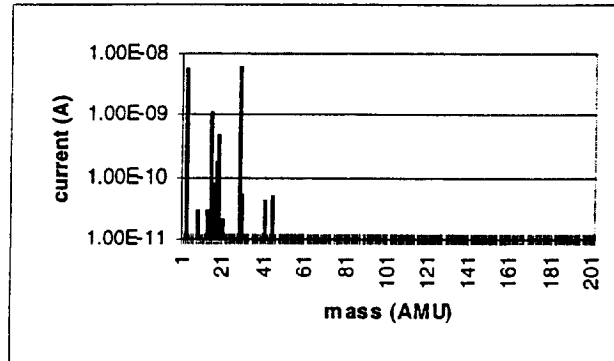


Fig. 9 Outgassing spectrum during the second heating at 150 °C

We switched off heating and we measured:

t(h)	T(°C)	p ₁ (mbar)	p ₂ (mbar)	Q(mbar l/s)
1299.3	30	7.3x10 ⁻¹⁰	2.2x10 ⁻¹⁰	1.0x10 ⁻⁸
1441.3	30	7.8x10 ⁻¹⁰	1.9x10 ⁻¹⁰	1.2x10 ⁻⁸
1469.5	30	9.3x10 ⁻¹⁰	2.3x10 ⁻¹⁰	1.4x10 ⁻⁸

A spectrum measured after the second thermal cycle is shown in Fig. 10.

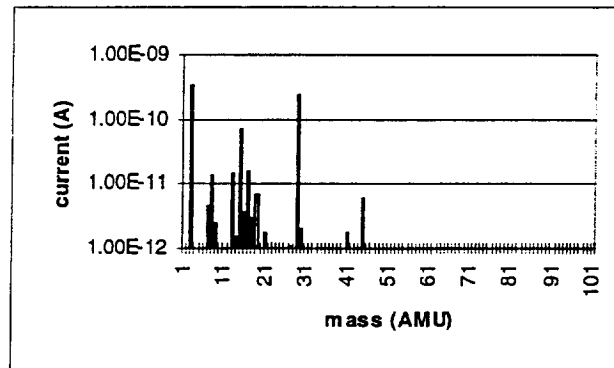


Fig. 10 Outgassing spectrum measured after the second thermal cycle

The outgassing rate evolution is summarized in Fig. 11.

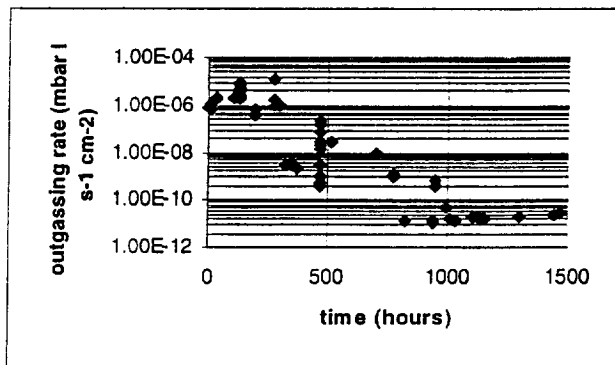


Fig. 11 Time evolution of the outgassing rate

3 - Discussion

The average outgassing rate measured for the Cibas magnets after the various thermal cycles was $\sim 1 \times 10^{-11}$ mbar l s⁻¹ cm⁻². The main results are similar to the results for Philips Ferroxdure 330 ferrite magnets with preliminary air baking (see note VACPISA 046). The ferrite magnets are usually prepared in normal ovens and without any particular care in handling and storing, thus contamination from whatsoever source is practically unavoidable. Since contamination appears any time the magnets are heated, the magnets should not be baked in situ. It is moreover worthy to note that the porosity of material causes them to act as virtual leaks.