



## PRESENTATION OF "GSA"

We are glad to submit to your attention our NEW PATENTED instrument **G S A** (Grain Size Analyser) which allows particle size characterisation of soil by sedimentation according to ASTM D 422 and UNI CEN ISO/TS 17892 – 4.

Particularly the **G S A** measures the finer fraction of soil from 0.1 mm to 0.001 mm.

The **G S A** is projected for realising multiple units till 12.



The software of **G S A**, easy and friendly, displays in real time the trend of the test through a graphic, giving to the operator before the end of the test, a reliable forecast of a trend useful in many cases to establish in advance the characteristic of the soil under test.

### PRINCIPAL CHARACTERISTICS

- 1- Range of density (specific gravity) from 0,9000 to 1,0500 with real four decimal figures.
- 2- Automatic compensation of variation of temperature and Stokes law.
- 3- Repeatability better than 2 %.
- 4- All the variable parameters, density of soil, acceleration of gravity, times of data acquisition etc. are programmable by the operator.

We have a unit of **G S A** available for testing any soil.

In addition see the report written by University of Modena using our **G S A** and an example of Excel test.

We will send you a new catalogue and prices in the case you are interested in additional information.

Best Regards.

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## **Testing a new instrument for particle-size analysis**

GSA (Grain Size Analyzer) allows particle size characterization of soils by measuring the progressive reduction of density in a soil suspension, following particle sedimentation during a given standard time of observation. This instrument makes use of the procedure prescribed by ASTM D422 standard norms applied to a modified hydrostatic balance for measuring density rather than by utilising standard 151H or 152H hydrometers.

In order to assess the correctness of this method, various comparative tests were carried out using the 152h standard hydrometer, according to the ASTM D422 norms, and GSA, the latter both in the 1000 ml and 500 ml version.

Considering the different capacity of the two vessels, the amounts of material used were proportionally adjusted. The dispersing agent utilised is sodium hexametaphosphate at 40‰ concentration in a mixture of 125 ml of Na + 875 ml of distilled water for the 1000 ml GSA – as recommended by the standard norms – whereas for the 500 ml GSA these values were proportionally reduced to 62 ml of Na + 438 ml of distilled water.

The hydrometer particle size test was carried out by acquiring data at 1, 2, 4, 8, 16, 30, 60, 120, 240, 480, 1440 minutes, respectively, whereas GSA makes use of an automatic method for continuous data acquisition.

All tests were carried out in order to verify several aspects:

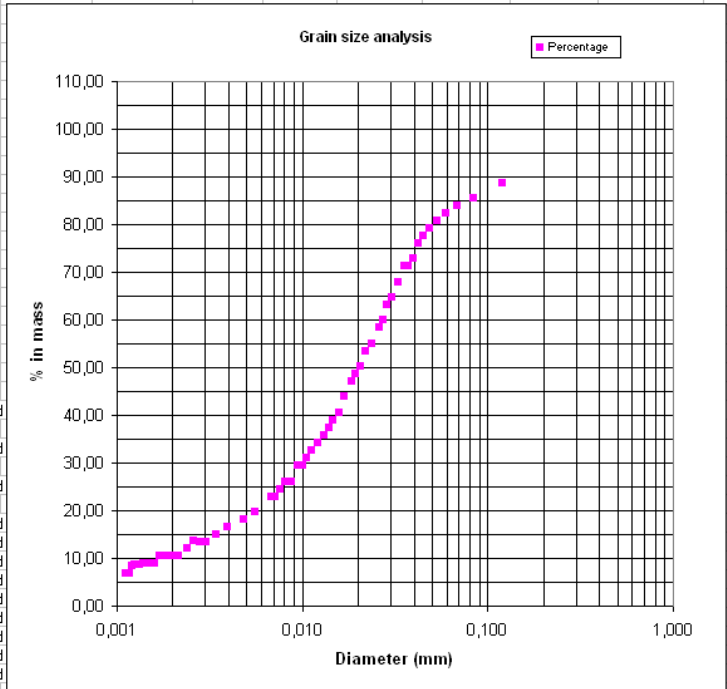
- correspondence between the two methodologies
- assessment of the effects of the reduction of the volume of suspension utilised
- assessment of the effect of the vessel bottom on particle size distribution
- assessment of the sand fraction
- repeatability of the tests

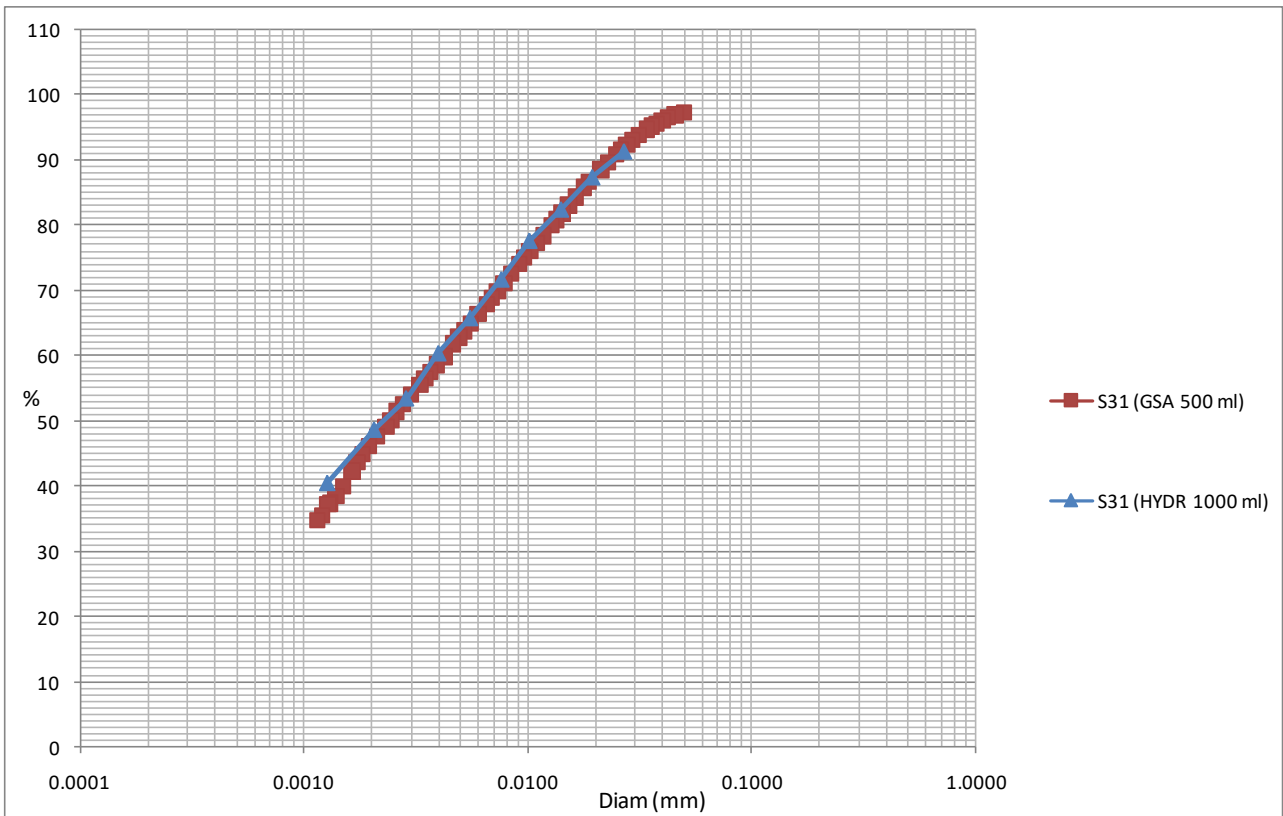
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A1	Time																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	P	Q	R	S	T	I
	Time	Specific Gravity	Temp.	Timer	Reading count	Last reading	Com port	Baudrate	Cal. Time (min.)	Space of reading (hours)	Space of reading (minutes)	Frequency of reading	Number of reading	Diameter (mm)	Percentage				
1																			
2	00:00:00.06	1,0315	22,0 °C	3600	60	22,29	3	9600	60	0	1	0,1	10	0,119	88,58				
3	00:00:00.12	1,0305	22,3 °C	3352						0	2	0,2	15	0,084	85,61				
4	00:00:00.18	1,0300	22,3 °C							0	4	0,4	20	0,068	84,05				
5	00:00:00.24	1,0295	22,3 °C							0	8	0,8	25	0,059	82,45				
6	00:00:00.30	1,0290	22,4 °C							0	16	1,5	30	0,053	80,85				
7	00:00:00.36	1,0285	22,4 °C							0	30	3,0	35	0,048	79,24				
8	00:00:00.42	1,0280	22,4 °C							1	0	15,0	37	0,045	77,63				
9	00:00:00.48	1,0275	22,4 °C							2	0	30,0	39	0,042	76,03				
10	00:00:00.54	1,0265	22,4 °C							4	0	30,0	43	0,040	72,80				
11	00:00:01.00	1,0260	22,4 °C							8	0	60,0	47	0,037	71,20				
12	00:00:01.06	1,0260	22,4 °C							24	0	60,0	63	0,036	71,20				
13	00:00:01.18	1,0250	22,4 °C											0,033	67,98				
14	00:00:01.30	1,0240	22,4 °C											0,031	64,76				
15	00:00:01.42	1,0235	22,4 °C											0,029	63,16				
16	00:00:01.54	1,0225	22,4 °C											0,027	59,94				
17	00:00:02.06	1,0220	22,4 °C											0,026	58,33				
18	00:00:02.30	1,0210	22,4 °C											0,024	55,11				
19	00:00:02.54	1,0205	22,4 °C											0,022	53,50				
20	00:00:03.18	1,0195	22,4 °C											0,021	50,28				
21	00:00:03.42	1,0190	22,4 °C											0,019	48,68				
22	00:00:04.06	1,0185	22,4 °C											0,019	47,06				
23	00:00:04.54	1,0175	22,4 °C											0,017	43,85				
24	00:00:05.42	1,0165	22,4 °C											0,016	40,63				
25	00:00:06.30	1,0160	22,4 °C											0,015	39,02				
26	00:00:07.18	1,0155	22,4 °C											0,014	37,41				
27	00:00:08.06	1,0150	22,4 °C											0,013	35,81				
28	00:00:09.36	1,0145	22,4 °C											0,012	34,20				
29	00:00:11.06	1,0140	22,4 °C											0,011	32,59				
30	00:00:12.36	1,0135	22,4 °C											0,011	30,98				
31	00:00:14.06	1,0130	22,4 °C											0,010	29,38				
32	00:00:15.36	1,0130	22,4 °C											0,009	29,38				
33	00:00:18.36	1,0120	22,4 °C											0,009	26,17				
34	00:00:21.36	1,0120	22,4 °C											0,008	26,17				
35	00:00:24.36	1,0115	22,4 °C											0,008	24,56				
36	00:00:27.36	1,0110	22,4 °C											0,007	22,95				
37	00:00:30.36	1,0110	22,4 °C											0,007	22,94				
38	00:00:45.36	1,0100	22,4 °C											0,006	19,71				
39	00:01:00.36	1,0095	22,4 °C	Calibrated										0,005	18,10				
40	00:01:30.36	1,0090	22,4 °C											0,004	16,52				
41	00:02:00.36	1,0085	22,5 °C	Calibrated										0,003	14,98				
42	00:02:30.36	1,0080	22,6 °C											0,003	13,45				
43	00:03:00.36	1,0080	22,7 °C	Calibrated										0,003	13,53				
44	00:03:30.36	1,0080	22,8 °C											0,003	13,60				
45	00:04:00.36	1,0075	22,9 °C	Calibrated										0,002	12,06				
46	00:05:00.36	1,0070	23,0 °C	Calibrated										0,002	10,54				
47	00:06:00.36	1,0070	23,1 °C	Calibrated										0,002	10,58				
48	00:07:00.36	1,0070	23,1 °C	Calibrated										0,002	10,60				
49	00:08:00.36	1,0070	23,1 °C	Calibrated										0,002	10,62				
50	00:09:00.36	1,0065	23,1 °C	Calibrated										0,002	9,01				
51	00:10:00.36	1,0065	23,0 °C	Calibrated										0,002	8,97				
52	00:11:00.36	1,0065	23,0 °C	Calibrated										0,001	8,90				
53	00:12:00.36	1,0065	22,9 °C	Calibrated										0,001	8,84				
54	00:12:08.44	1,0065	22,9 °C											0,001	8,83				

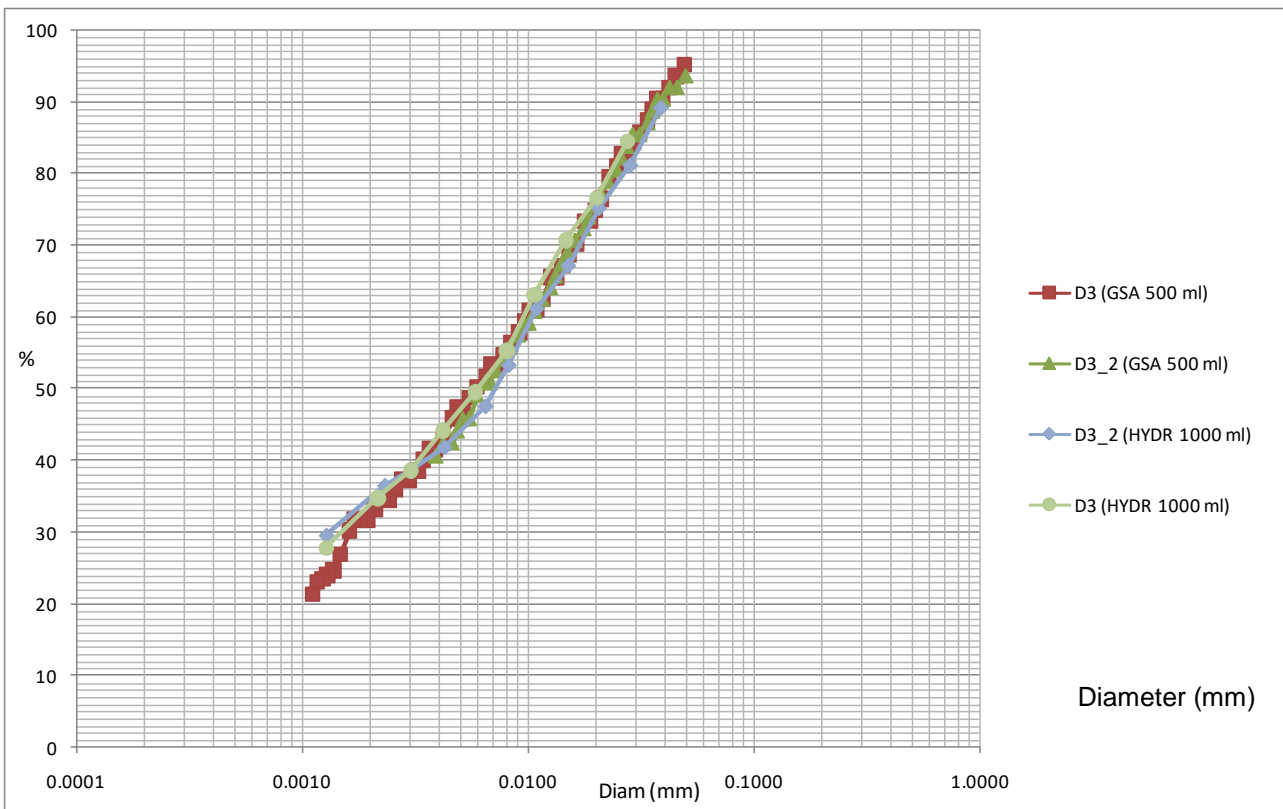
Start

Note:

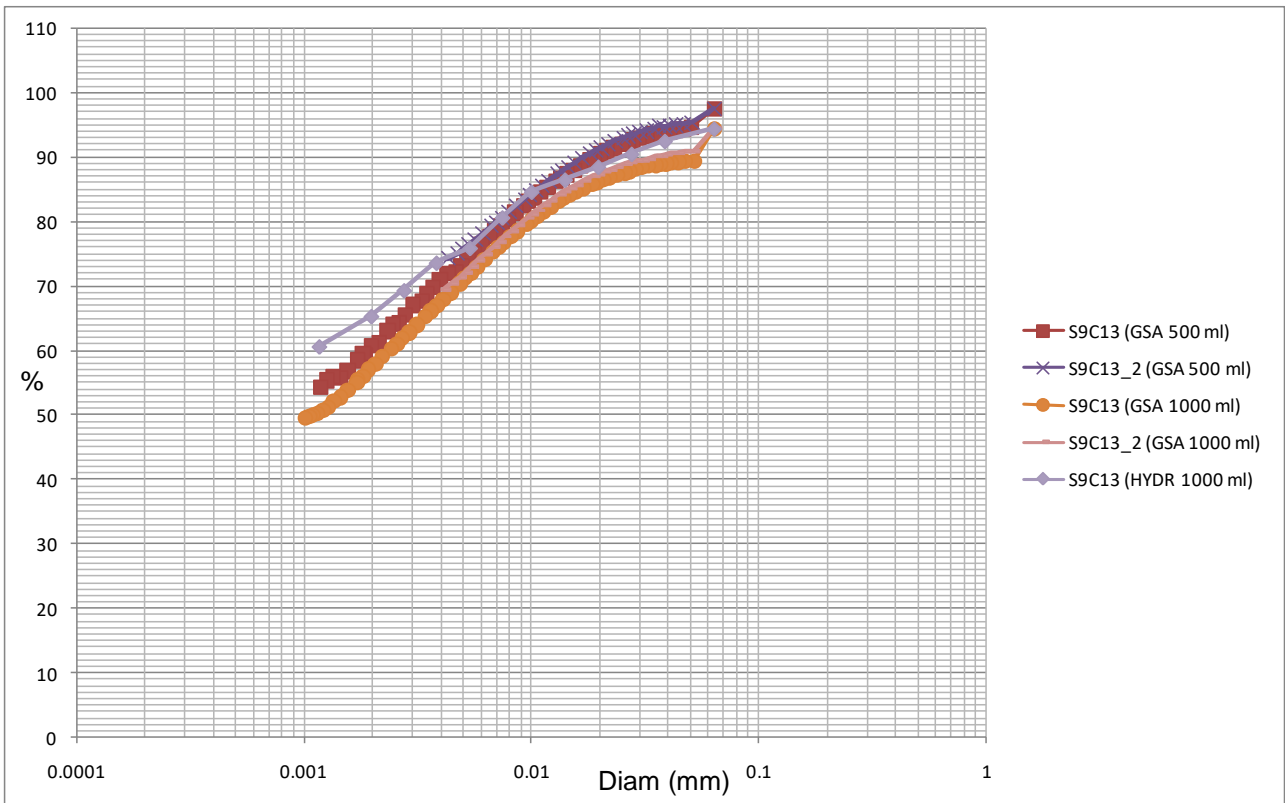




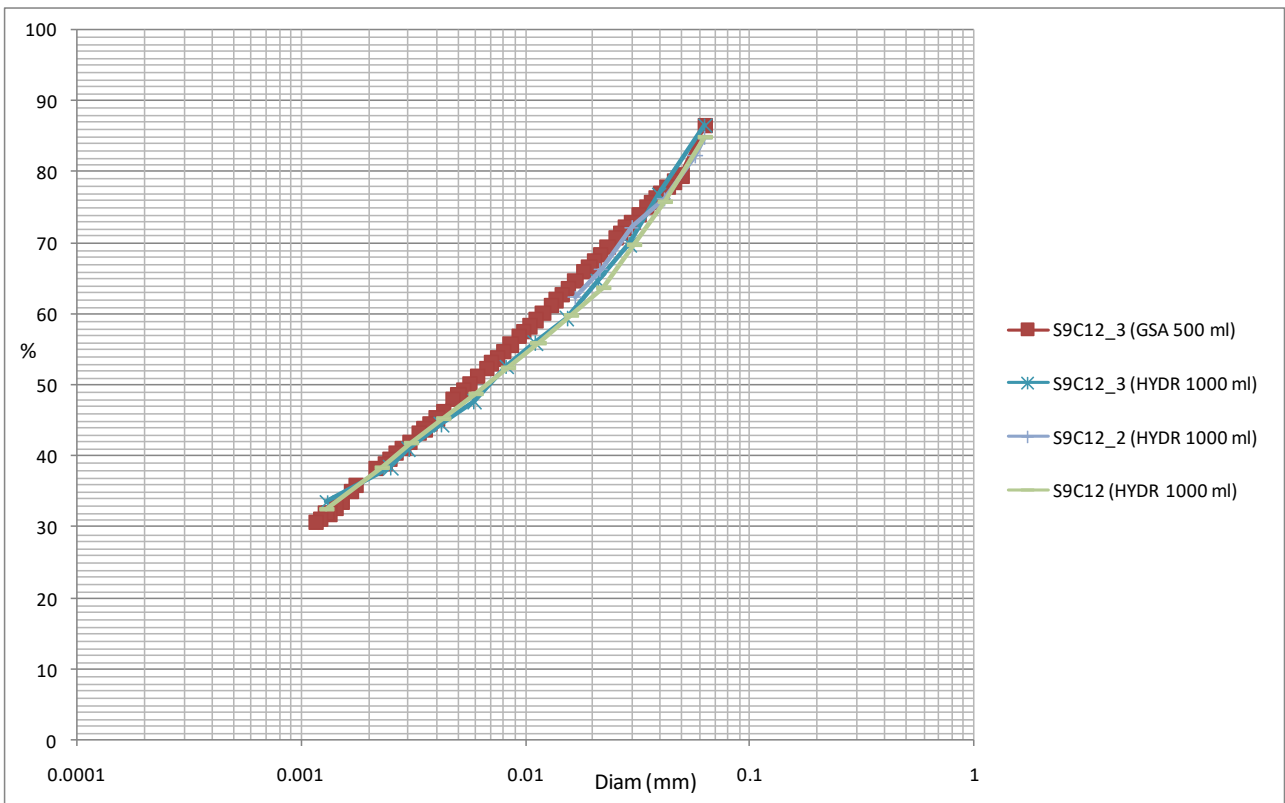
*Particle size correspondences between hydrometer and GSA tests*



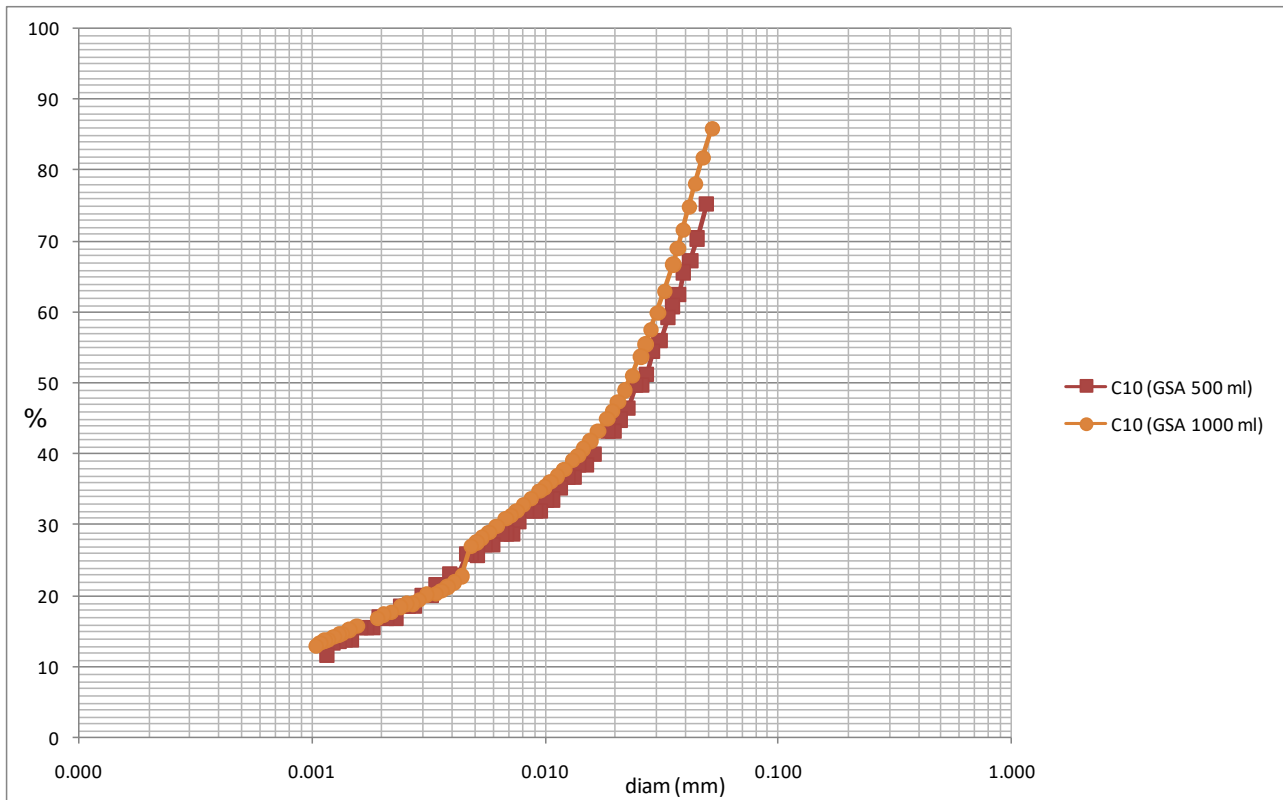
*Particle size correspondences between hydrometer and GSA tests by using, for the latter, 500 ml rather than 1000 ml of suspension. It is possible to appreciate the repeatability of the tests carried out by means of the two tests*



*Comparison curves between hydrometer, GSA (1000 ml), GSA (500 ml) tests and repeatability of GSA tests, respectively*



*Correspondence between GSA test on sifted sample and hydrometer tests on sifted and non-sifted samples, respectively*



*Correspondence between GSA tests using 1000 ml and 500 ml suspensions, respectively*

By means of these comparative tests, it was possible to demonstrate: a) the correspondence of the results obtained by GSA tests with those achieved according to the prescribed standard methodology; b) the perfect repeatability of the tests.

In addition, the possibility to reduce the suspension volume at 500 ml was verified, by reducing accordingly the amounts of sample and sodium hexametaphosphate used. In this way, by considering the reduction of lengths, the time necessary to carry out a complete particle size analysis is considerably reduced [the silt-clay boundary ( $2\ \mu\text{m}$ ) is attained already after 4 hours, therefore the test is completed after 8 hours]. This can be considered a great advantage with respect to the traditional procedure.

The first identifiable diameter, by means of GSA and similarly to the hydrometer test, is 0.061 mm, that is in proximity of the sand-silt boundary. Therefore, in order to carry out a complete particle size analysis, it is not possible to leave out of consideration the use of sieves which allow weight percentages to be assessed. Indeed, these percentages cannot be measured by means of GSA.

Finally, the following aspects should also be considered: a) the perfect repeatability of the tests; b) the possibility to draw a graph in real time with a continuous curve; c) the direct attainment of the curve values (percentages,  $D_{60}$ ,  $D_{10}$  parameters etc.) rather than using interpolation procedures which are always affected by error.

Modena, 6 May 2009