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Jet Erosion Tests on samples coming from Hedwige-Prosperpolder

Photo: Mischa Keijser

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Adaptation to climate change

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Jet Erosion Tests on samples coming from Hedwige-Prosperpolder

Geotechnical survey report

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GeoPhyConsult

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Erosion Tests Laboratory

Jet Erosion Tests on samples coming from Hedwige-Prosperpolder

Summary: The present report is devoted to the results of Jet Erosion Tests campaign carried out by geophy*Consult* on soil samples coming from the clayey shell of the Hedwige-Prosperpolder levees, in the frame of the Polder2C's project.

During sampling a vertical gradient of soil characteristics is observed. Roots are found, as well as locally a rumble-like structure of the soil.

From the identification tests, a relatively homogeneous constitution of the cover layer is identified: an organic silty sand, with rather low plasticity. Locally slightly finer (more cohesive) and coarser (sand fraction) soil is identified.

Jet Erosion Tests lead to critical stresses between 9 and 180 Pa (mean value 70 Pa) and Hanson erosion coefficients between 0.4 and 110 $cm^3/(N.s)$ (mean value 23 $cm^3/(N.s)$) corresponding to an intermediate resistance compared to geophyConsult database. The erosion law tends to be bi-linear for half of the tests, as frequently observed for erosion tests: different τ_c and k_d parameter should be used depending on the range of shear stress applied.

No clear difference is observed between A (surface) and B (deeper) samples. Soil from section II seems slightly less resistant than the rest of the samples and soil from positions IV.6 and IV.7 slightly more resistant.

Addressee: - ..... Davy DEPREITER

Copy: - ..... Patrik PEETERS

Execution of the tests:	Guillaume Davion, *Technician*	
Drafter:	Maxime Boucher, *Engineer*	
Controller:	Rémi Béguin, *Fibre Optics expert*	

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geophy*Consult*, Société par Actions Simplifiée au capital de 10 000 €
Headquarters : 159, quai des Allobroges – 73 000 Chambéry – France
Erosion Tests Laboratory : Sup'Agro – geophy*Consult* – Bâtiment 2 – 2, place Pierre Viala – 34 060 Montpellier cedex 02 – France
Registration number : 521 005 041 RCS Chambéry – French Registration code : 7120B
SIRET : 521 005 041 00038 (headquarters) – 521 005 041 00020 (lab) – European V.A.T. number : FR 09 521 005 041
Tel. : +33 6 85 81 79 68 – Fax : +33 9 56 67 61 37
E-mail : administration@geophyConsult.com – Web site : http://www.geophyConsult.com/

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1 Introduction

The Polder2C's project takes advantage of the depoldering of Hedwige Prosperpolder to perform research on levees, including research on resistance to erosion during overflowing and overtopping events. To provide entry data for modeling and experimental tests, Flanders Hydraulics Research asked to geophy*Consult* to perform Jet Erosion Test on the cover layer of these levees.

The specification of these tests was based on the document "Price request Erosion Tests P2C.pdf"; geophy*Consult* technical offer 2020-21; and telephone and email discussions with Davy Depreiter. The missions were to:

1. conduct sampling campaign on Hedwige-Prosperpolder site;
2. carry out 20 Jet Erosion Tests in laboratory, on intact samples;
3. sub-contract the associated identification tests.

The present report is the answer to the corresponding order n°20034744 transmitted by Vlaamse Overheid. It is divided up into four parts. To begin with, the sampling campaign is described (§2), and the test program is presented (§3). Then, the results of the identification tests (§4), and the jet erosion tests (§5), are detailed.

2 Sampling campaign

2.1 Sampling method

The main purpose of the project is to study the resistance to erosion of the cover layer of the Polder2C's levee (few decimeter thick), and not the dike body, constituted mainly of sand. At the request of geophy*Consult,* the plant cover was removed before the sampling campaign (~5 cm thick), over approximately 6 m² on each sampling area (Picture 1). Two types of samples were then taken by geophy*Consul*:

- intact soil samples for performing JET and measuring wet densities;
- bulk soil samples, in bags, for other identification tests.

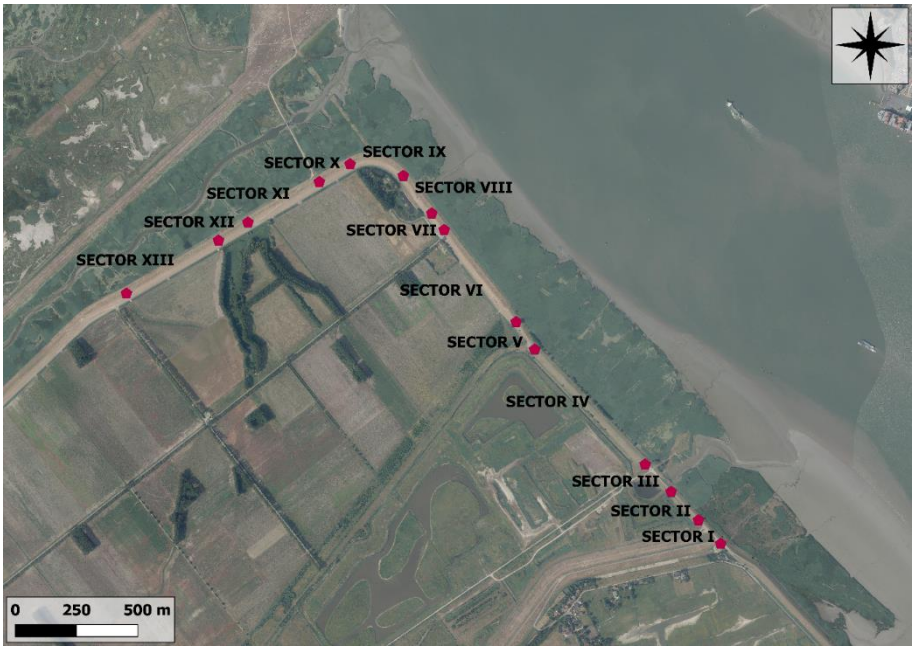
Intact samples were taken using core cutter (steel cylinders ~18 cm high and ~15 cm in diameter, whose one of the sections is beveled). The core cutters are manually driven into the ground using a metal cap and a sledgehammer. After driving into, the core cutters are meticulously extract, cut out on both sides and hermetically sealed with taped plastic caps (Picture 1).

Picture 1. Sampling illustrations.

2.2 Sampling location

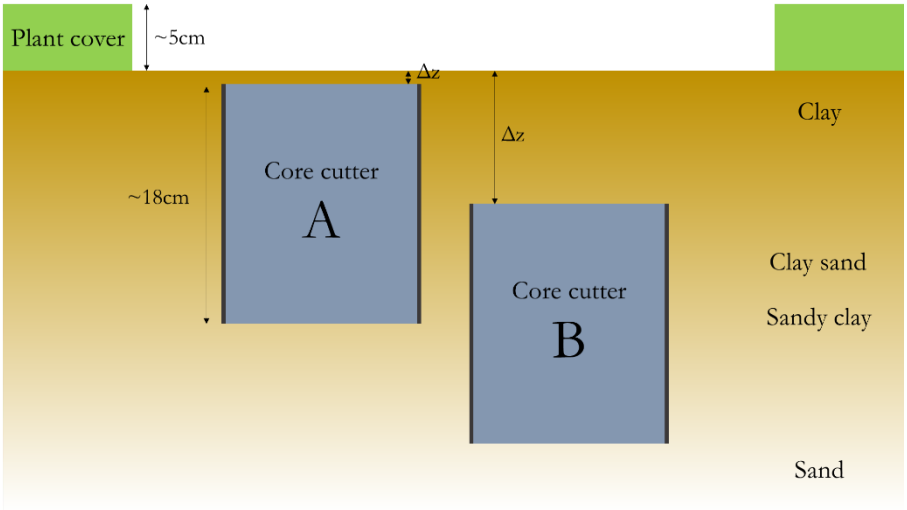
The dike, straddling Belgium and the Netherlands, is divided into sectors numbered in Roman numerals from I to XIII (Picture 2).

On each sector, a certain number of sampling zones, numbered in Arabic numerals, were defined (1 to 7 depending on the sector). These zones are located in the upper or the lower part of the downstream side of the dike, distributed over the entire section in order to multiply the tests and to have an idea of the heterogeneity of the materials and their erosion parameters.



Picture 2. Delimitation of dike sections.

The thickness of the clay shell being locally of the same order of magnitude as the height of the core cutters, the samples were mostly taken at the surface after plant cover removing. However, as vertical gradients were identified during sampling, some samples were taken slightly deeper. The samples are named A or B according to the sampling depth (Picture 3).



Picture 3. Sampling depth.

The list of samples taken is summarized in the table below (Table 1):

Samples location			Sample characteristics					Planned tests					
			Intact soil samples		Number of bulk soil bags								
Sections	Upper / Lower	Zones	Depth ("A" or "B")	Δz (m)	Small bags	Big bags	Comments	JET	Water content	Density	Sieve analysis	Atterberg limits	Proctor
II	Upper	1	A	0	1		-	1	1	1			
			B	0,18	1		Indurated sand						
		2	A	0	1	3	-	1	1	1	1	1	1
			B	0,15	1		Indurated sand	1	1	1	1		
		3	A	0	1		Soft soil						
IV	Upper	1	A	0	1		-	1	1	1			
			B	0,21	1		Very cracked clay, dry						
		2	A	0	1	2	-	1	1	1	1	1	1
			B	0,13	1		Cracked clay, dry	1	1	1	1		
		3	A	0	1		-						
		4	A	0	1		-	1	1	1			
		5	A	0	1		-	1	1	1			
		6	A	0	1	3	-	1	1	1		1	
		7	A	0	1		-	1	1	1			
			B	0,15	1		Cracked clay, dry						
VI	Lower	1	A	0	1		-	1	1	1			
		2	A	0	1	2	-	1	1	1	1	1	
		3	A	0	1		-	1	1	1			
		4	A	0	1		-	1	1	1			
		5	A	0	1		-	1	1	1			
		6	A	0	1	3	-	1	1	1	1	1	1
			B	0,15	1		Little cracked clay	1	1	1			
		7	A	0	1		Stone at the bottom of the sample						
X	Lower	1	A	0,03	1	2	A little deeper than the other "A"	1	1	1		1	
XII	Lower	1	A	0	1		-	1	1	1			
XII	Lower	1	A	0	1		-	1	1	1			

Table 1. Characteristics of samples taken and planned tests.

2.3 Sampling weather conditions

The sampling campaign was carried out on July 9, 2020, following a rainy week (with in particular heavy rain the day before the sampling), following 3 months of drought (falling within a more general framework of 3 years of rather dry weather).

On the day of the sampling campaign, the weather was windy, with rare and light showers.

2.4 Sampling observations

Observation and first feelings after the samples:

- The top 10 centimeters of the soil is significantly darker (see Picture 4) - probably due to humidity from the rains in the week before sampling and dur to high organic content. As the core cutters were 18 cm high, samples A were cut through these two layers. As the B samples were taken lower, they all came from the second layer that seems dryer/less organic.
- Soil presenting a root system that is still important despite the depth (see Picture 5, Picture 5 and Picture 9).
- Soil of the deeper layer breaking down into clods in some locations (mainly IV) leading to a "rubble-like structure". A careful observation of the soil behavior during sampling and discussions with Davy Depreiter lead to the conclusions that this weathering was not induced by the sampling process, but could be linked to the drought of the previous years, as observed in other places in Holland [1].

Picture 4. Vertical water content gradient suspected during sampling.

Picture 5. Soil breaking into clods.

2.5 Transport and storage of samples

On July 10, the samples were transported by van to the geophy*Consult* laboratory in Montpellier. The samples were then stored indoors and were not opened until the tests were carried out.

3 Testing program

The list of ordered tests is detailed in Table 1. Jet Erosion Test, water content and density measurements are carried out by geophy*Consult*. Grain size analysis, Atterberg limits and Proctor tests are subcontracted by geophy*Consult* to the Ginger CEBTP Jacou laboratory (France).

4 Identification results

4.1 Water contents

The water content measurements were obtained from weighing of the soil transported in small bags (Table 1) before and after 24 hours of steaming at 105 °C. The results are given in Table 3 (and shown Picture 8).

It can be noted that:

- A variable water content, but significantly lower on section II for samples "A".
- A lower water contents for samples "B" than samples "A" on sections II and IV, but of the same order for samples "A" and "B" on section VI.

4.2 Densities

The density (dry and wet) were obtained from the dimensions and masses measurements of the core cutters (Table 1).The results are given in Table 3 (and shown Picture 8).

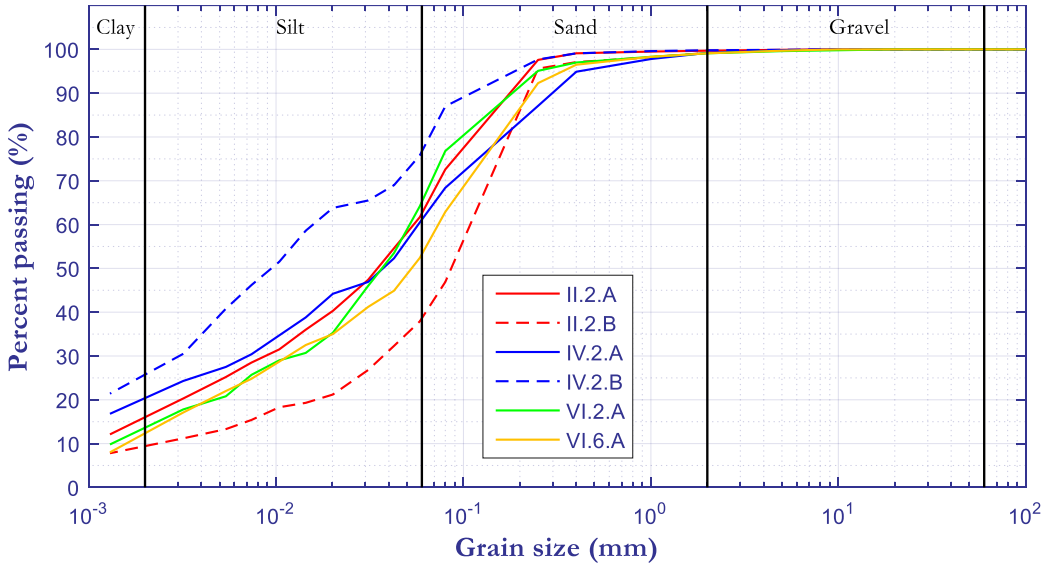
No distinct trend emerges from the results. Dry densities are relatively dispersed, with values between 1.24 and 1.59 along sections II, IV, VI, X, XI and XII.

4.3 Grain size analysis

Grain size analysis were carried out on soil transported in big bags (Table 1). Fractions greater than 80 µm were obtained by sieving and those lower were obtained by sedimentometry. The results are presented in Picture 6 and summarized in Table 3.

The results show a relatively slim batch of grading curve for the "A" samples, constituted of silt (~40 to 50%), sand (~40%) and some clay (10-20 %). Sample IV.2.A have a slightly higher 2 µm content.

For the samples "B" a clear distinction is visible between II.2.B coarser (~65% of sand) and IV.2.B finer (~25% of clay and ~50% of silt).

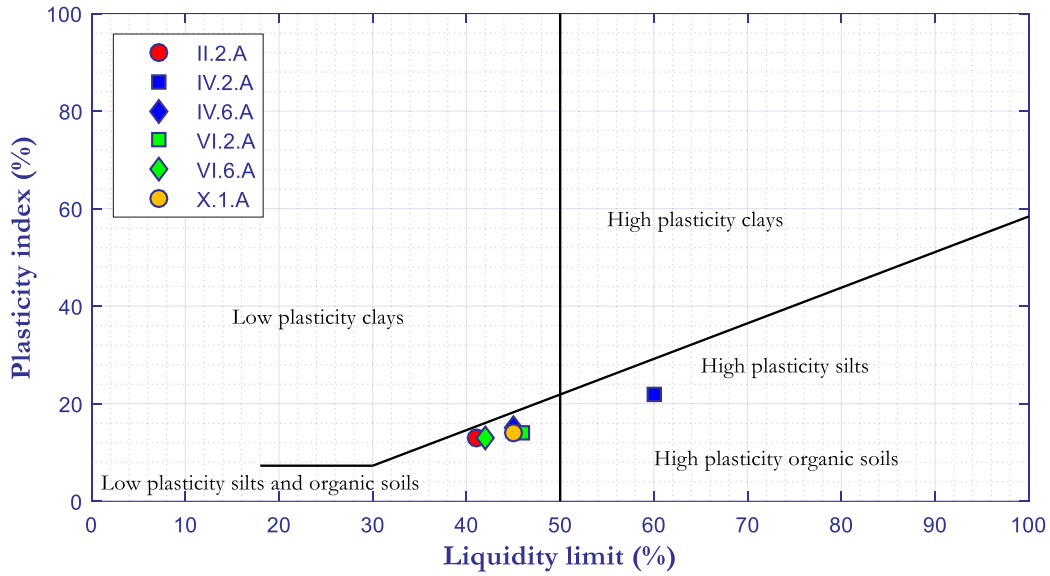


Picture 6. Granulometric analysis results.

4.4 Atterberg limits

Atterberg limits were carried out on big bags (Table 1). The results are presented in Casagrande diagram (Picture 7) and summarized in Table 3.

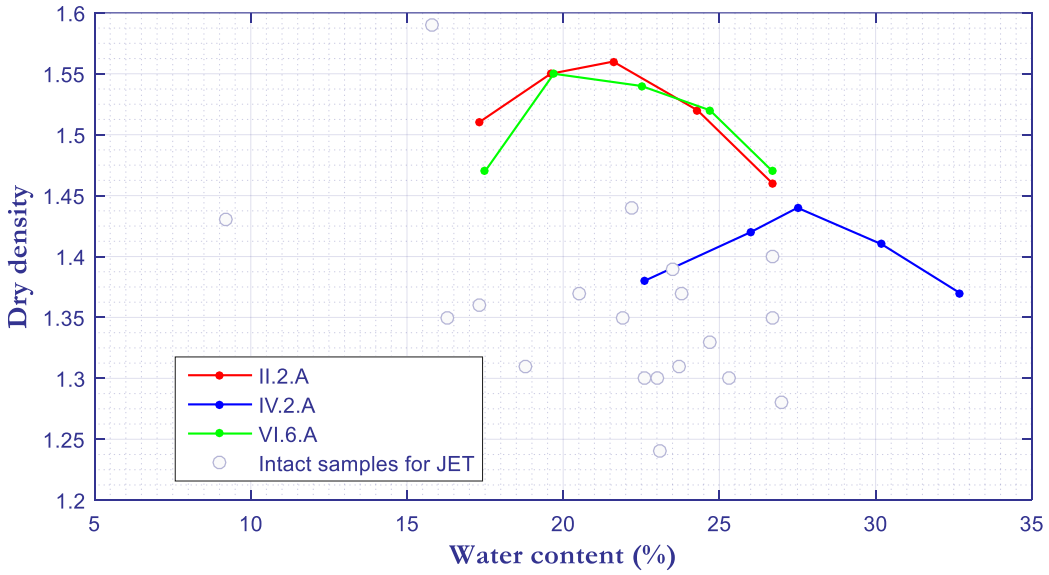
Homogeneous results have been obtained with clayey and/or organic soils with low plasticity (I_p = 13 to 15 %); except for sample IV.2.A which have a significantly higher plasticity (22 %) concordant with a higher < 2 µm content.



Picture 7. Atterberg limits in Casagrande diagram.

4.5 Proctors

Proctor tests were carried out on big bags (Table 1). The results are presented Picture 7 and summarized in Table 3.



Picture 8. Proctor results.

4.6 Organic content

Organic content measurements have been performed by Davy Depreiter and transmitted to geophy*Consult*. Values range from 2,1 to 4,2 %, with samples from section II having lower values.

Sample	Organic matter content	Carbonate
II_J1	2.32 %	7.34 %
II_J2	2.57 %	7.48 %
II_J3	2.15 %	8.48 %
IV_J1	3.57 %	9.82 %
IV_J2	3.52 %	9.90 %
IV_J3	4.23 %	11.52 %
IV_J4	3.30 %	10.13 %
IV_J5	2.72 %	7.50 %
IV_J6	4.18 %	10.70 %
IV_J7	3.75 %	10.48 %
VI_J1	3.51 %	11.78 %
VI_J2	3.69 %	11.46 %
VI_J3	2.87 %	9.43 %
VI_J4	3.74 %	11.20 %
VI_J5	3.13 %	10.08 %
VI_J6	3.06 %	11.44 %
VI_J7	3.24 %	12.99 %
X_J1	2.37 %	8.46 %
XI_J1	3.15 %	9.84 %
XII_J1	3.58 %	10.63 %

Table 2. Organic content results transmitted by Davy Depreiter to geophy*Consult*.

4.7 Synthesis

The identifications tests underline a homogeneity of the "A" samples, being mainly silty sand with rather low plasticity. Sample IV.2.A seems slightly more cohesive.

Samples "B" differ with II.2.B being clearly coarser and IV.2.B finer. The sampling observation of wetter soil for B samples is confirmed II.2.B and IV.2.B but not for VI.6.B.

Note that densities are variable for all samples.

Name of the test	Hydric state		Grain size analysis			Atterberg limits		Proctor test	
	Water content (C)	Dry density (ρs)	Passing at 2 µm	Passing at 80 µm	Passing at 2 mm	Plasticity index (I_p)	Liquidity limit (W_L)	Optimal water content (C_{opt})	Optimal dry density (ρ_{Sopti})
SII_E1_A	15.8 %	1.59							
SII_E2_A	16.3 %	1.35	15.1%	72.9 %	99.7 %	13	41 %	21.6 %	1.56
SII_E2_B	9.2 %	1.43	9.1 %	46.9 %	99.2 %				
SIV_E1_A	20.5 %	1.37							
SIV_E2_A	26.7 %	1.35	19.7 %	68.4 %	99.2 %	22	60 %	27.5 %	1.44
SIV_E2_B	17.2 %	1.29	24.9 %	87.0 %	99.8 %				
SIV_E4_A	26.7 %	1.40							
SIV_E5_A	27.0 %	1.28							
SIV_E6_A	24.7 %	1.33				15	45 %		
SIV_E7_A	22.2 %	1.44							
SVI_E1_A	23.8 %	1.37							
SVI_E2_A	25.3 %	1.30	14.9 %	76.8 %	99.1 %	14	46 %		
SVI_E3_A	18.8 %	1.31							
SVI_E4_A	22.6 %	1.30							
SVI_E5_A	23.7 %	1.31							
SVI_E6_A	23.5 %	1.39	11.4 %	62.9 %	99.1 %	13	29 %	19.7 %	1.55
SVI_E6_B	23.0 %	1.30							
SX_E1_A	17.3 %	1.36				14	45 %		
SXI_E1_A	23.1 %	1.24							
SXII_E1_A	21.9 %	1.35							

Table 3. Identification results (the passing to 2 µm are interpolated values).

5 Jet Erosion Tests results

5.1 Samples preparation

All the samples were tested intact, with their roots, in their core cutters. The upper face was subjected to erosion, as that would be the case on site.

5.2 Operating procedure and apparatus

The tests were carried out after a sample immersion time of the order of ten minutes according to the Greg Hanson standard (§8). The applied hydraulic load was then adjusted in order to, on the one hand, not over-stress the sample so that the measured erosion curve can be precisely described, and on the other hand, stress enough the sample so that a significant scour depth can be generated (greater than 2 cm) – knowing that the experimental set up only allow application stress between 2 and 750 Pa.

During this test campaign, hydraulic load was adjusted binary to ~2 or ~8 mCe (see Table 4), depending on the apparent resistance of the samples during their preparation. The good adaptation of these loads made it possible to systematically obtain, at the end of these tests, sufficient final scourings (between 2.2 and 12.5 cm), compatible with the modellings.

The samples were tested with a jet diameter of 6.35 mm (corresponding to 1/4" - in accordance with Greg Hanson's standard) and with the public water provider from the city of Montpellier.

5.3 Results

The results obtained for Jet Erosion Tests are summarized in Table 4.

For half of the tests, a bi-linear behavior of the erosion law is observed (with a decrease in the values of the critical stress and the erosion rate at the end of the test, when the applied stresses are lower). This behavior is classic in erosion tests [2] and in JET tests [5], [6]. Among the most common influencing factors, we can list:

- the predominance of two distinct and successive erosion mechanisms:
  - A tendency to erosion by clods of soil under strong hydraulic stresses, sufficient to break soil bulk resistance (such as the case at the start of the test, with a high erosion rate).
  - A tendency to erosion by grains of soil under lower hydraulic stresses (such as the case at the end of the test, with a significative drop in the erosion rate and a slightly less significant drop in the critical stress).
- The local variability of the parameters of resistance to erosion at the scale of soil particles and hydraulic loading, which tend to smooth the beginning of the theoretical erosion law (see [2] for demonstration of the impact of the distribution of resistance/loading) .
- The progressive saturation of the soil, which generate some particles detachment at longer time

Name of the test	Test setup				Measuring range			Critical stress (τc)		Hanson erosion coefficient (Kd)	
	Sample type	Jet diameter (d_0)	Hydraulic load applied (h)	Sample heigh	Scour range generated	Scour range retained	Associated stress range	**Retained**	Confidence interval	**Retained**	Confidence interval
SII_E1_A	Intact	6.35 mm	2.25 ± 0.04 mCe	18.0 cm	0.0 - 8.0 cm	0.0 - 7.2 cm	21 - 97 Pa	**23 Pa**	18 - 27 Pa	**110 cm3/(N.s)**	94 - 120 cm3/(N.s)
SII_E2_A	Intact	6.35 mm	2.28 ± 0.02 mCe	18.0 cm	0.0 - 5.8 cm	0.0 - 3.3 cm	48 - 114 Pa	**48 Pa**	40 - 56 Pa	**58 cm3/(N.s)**	50 - 67 cm3/(N.s)
						3.5 - 5.8 cm	28 - 45 Pa	**30 Pa**	24 - 36 Pa	**2 cm3/(N.s)**	1.4 - 2.7 cm3/(N.s)
SII_E2_B	Intact	6.35 mm	2.32 ± 0.02 mCe	18.0 cm	0.0 - 12.5 cm	0.0 - 5.3 cm	32 - 129 Pa	**37 Pa**	22 - 52 Pa	**27 cm3/(N.s)**	20 - 35 cm3/(N.s)
						6.4 - 12.5 cm	10 - 23 Pa	**9 Pa**	5 - 13 Pa	**3.5 cm3/(N.s)**	2.3 - 4.7 cm3/(N.s)
SIV_E1_A	Intact	6.35 mm	2.34 ± 0.03 mCe	18.0 cm	0.0 - 5.5 cm	2.5 - 4.4 cm	39 - 61 Pa	**42 Pa**	36 - 48 Pa	**19 cm3/(N.s)**	14 - 24 cm3/(N.s)
SIV_E2_A	Intact	6.35 mm	1.95 ± 0.02 mCe	18.0 cm	0.0 - 2.2 cm	0.0 - 0.7 cm	77 - 94 Pa	**80 Pa**	61 - 98 Pa	**49 cm3/(N.s)**	17 - 81 cm3/(N.s)
						0.9 - 2.2 cm	49 - 70 Pa	**51 Pa**	38 - 64 Pa	**0.41 cm3/(N.s)**	0.23 - 0.59 cm3/(N.s)
SIV_E2_B	Intact	6.35 mm	2.34 ± 0.02 mCe	18.0 cm	0.0 - 5.3 cm	1.7 - 4.4 cm	40 - 80 Pa	**42 Pa**	24 - 59 Pa	**6.2 cm3/(N.s)**	3.5 - 8.9 cm3/(N.s)
SIV_E4_A	Intact	6.35 mm	2.19 ± 0.02 mCe	18.0 cm	0.0 - 3.1 cm	0.0 - 1.7 cm	73 - 126 Pa	**78 Pa**	49 - 110 Pa	**9.6 cm3/(N.s)**	5.1 - 14 cm3/(N.s)
						1.7 - 3.1 cm	47 - 69 Pa	**49 Pa**	37 - 60 Pa	**0.64 cm3/(N.s)**	0.39 - 0.88 cm3/(N.s)
SIV_E5_A	Intact	6.35 mm	2.34 ± 0.03 mCe	18.0 cm	0.0 - 2.8 cm	0.8 - 2.3 cm	62 - 100 Pa	**65 Pa**	51 - 78 Pa	**8.5 cm3/(N.s)**	6 - 11 cm3/(N.s)
SIV_E6_A	Intact	6.35 mm	8.30 ± 0.10 mCe	18.0 cm	0.0 - 3.4 cm	0.0 - 3.4 cm	175 - 427 Pa	**180 Pa**	160 - 200 Pa	**19 cm3/(N.s)**	17 - 22 cm3/(N.s)
SIV_E7_A	Intact	6.35 mm	8.29 ± 0.08 mCe	18.0 cm	0.0 - 3.9 cm	0.0 - 3.9 cm	155 - 439 Pa	**180 Pa**	76 - 280 Pa	**9.6 cm3/(N.s)**	4.1 - 15 cm3/(N.s)
SVI_E1_A	Intact	6.35 mm	8.30 ± 0.10 mCe	18.0 cm	0.0 - 6.8 cm	4.4 - 5.1 cm	115 - 129 Pa	**110 Pa**	100 - 120 Pa	**44 cm3/(N.s)**	35 - 53 cm3/(N.s)
						5.1 - 6.8 cm	83 - 112 Pa	**85 Pa**	74 - 97 Pa	**3.6 cm3/(N.s)**	2.6 - 4.5 cm3/(N.s)
SVI_E2_A	Intact	6.35 mm	8.29 ± 0.11 mCe	18.0 cm	0.0 - 8.2 cm	4.6 - 5.7 cm	105 - 128 Pa	**100 Pa**	82 - 120 Pa	**9.5 cm3/(N.s)**	5.9 - 13 cm3/(N.s)
						5.5 - 8.2 cm	68 - 105 Pa	**68 Pa**	61 - 75 Pa	**1.2 cm3/(N.s)**	1 - 1.4 cm3/(N.s)
SVI_E3_A	Intact	6.35 mm	8.29 ± 0.12 mCe	18.0 cm	0.0 - 8.8 cm	4.3 - 8.8 cm	58 - 126 Pa	**62 Pa**	40 - 84 Pa	**16 cm3/(N.s)**	9.8 - 22 cm3/(N.s)
SVI_E4_A	Intact	6.35 mm	8.29 ± 0.11 mCe	18.0 cm	0.0 - 7.9 cm	4.3 - 7.9 cm	67 - 128 Pa	**70 Pa**	42 - 98 Pa	**16 cm3/(N.s)**	8.4 - 24 cm3/(N.s)
SVI_E5_A	Intact	6.35 mm	8.29 ± 0.11 mCe	18.0 cm	0.0 - 10.4 cm	4.5 - 10.4 cm	49 - 112 Pa	**52 Pa**	42 - 61 Pa	**24 cm3/(N.s)**	19 - 29 cm3/(N.s)
SVI_E6_A	Intact	6.35 mm	8.29 ± 0.12 mCe	18.0 cm	0.0 - 6.0 cm	3.2 - 4.7 cm	128 - 166 Pa	**130 Pa**	95 - 170 Pa	**57 cm3/(N.s)**	19 - 95 cm3/(N.s)
						4.7 - 6.0 cm	100 - 124 Pa	**97 Pa**	80 - 110 Pa	**1.1 cm3/(N.s)**	0.79 - 1.4 cm3/(N.s)
SVI_E6_B	Intact	6.35 mm	6.31 ± 0.09 mCe	18.0 cm	0.0 - 6.3 cm	0.0 - 3.9 cm	111 - 276 Pa	**120 Pa**	86 - 150 Pa	**33 cm3/(N.s)**	24 - 42 cm3/(N.s)
						3.9 - 6.3 cm	67 - 105 Pa	**65 Pa**	52 - 79 Pa	**2.2 cm3/(N.s)**	1.7 - 2.8 cm3/(N.s)
SX_E1_A	Intact	6.35 mm	8.30 ± 0.12 mCe	18.0 cm	0.0 - 12.0 cm	4.2 - 8.8 cm	63 - 121 Pa	**63 Pa**	51 - 76 Pa	**110 cm3/(N.s)**	84 - 130 cm3/(N.s)
						8.8 - 12.0 cm	41 - 61 Pa	**36 Pa**	19 - 53 Pa	**5.2 cm3/(N.s)**	2.8 - 7.7 cm3/(N.s)
SXI_E1_A	Intact	6.35 mm	8.29 ± 0.11 mCe	18.0 cm	0.0 - 8.3 cm	4.2 - 8.3 cm	67 - 135 Pa	**72 Pa**	56 - 89 Pa	**24 cm3/(N.s)**	17 - 31 cm3/(N.s)
SXII_E1_A	Intact	6.35 mm	2.31 ± 0.05 mCe	18.0 cm	0.0 - 5.2 cm	1.0 - 3.8 cm	41 - 88 Pa	**41 Pa**	28 - 55 Pa	**7.2 cm3/(N.s)**	5 - 9.3 cm3/(N.s)
						4.0 - 5.2 cm	30 - 37 Pa	**30 Pa**	23 - 38 Pa	**0.82 cm3/(N.s)**	0.31 - 1.3 cm3/(N.s)

Table 4. Jet Erosion Tests results.

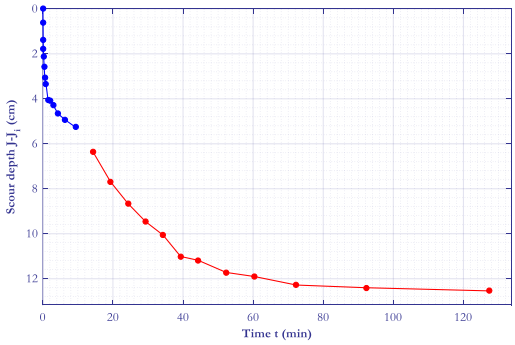
In the particular case of this test study, we can also add and/or insist on:

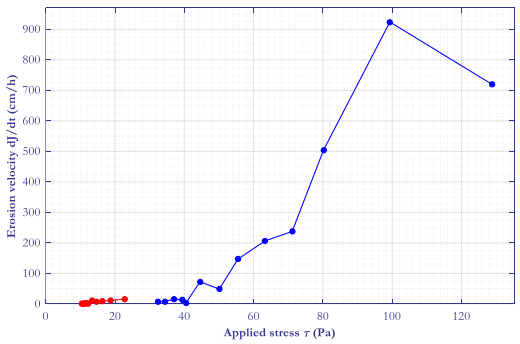
- The visual observation of a vertical gradient in the soil characteristics (see Picture 4) which can generate/accentuate the bi-linearity of the erosion law as a function of the depth.
- The pronounced presence of clods of soil for some samples (Picture 9), which can accentuate erosion by clod under high stress (detachment of complete clods) then by grains of soil under low stress (erosion in the sense of the development of Jet Erosion Test by Greg Hanson).
- The presence, at any height, of a dense root system, accentuating the local variability of soil erosion parameters and hydraulic loading (thus accentuating the non-linearity of the erosion law).

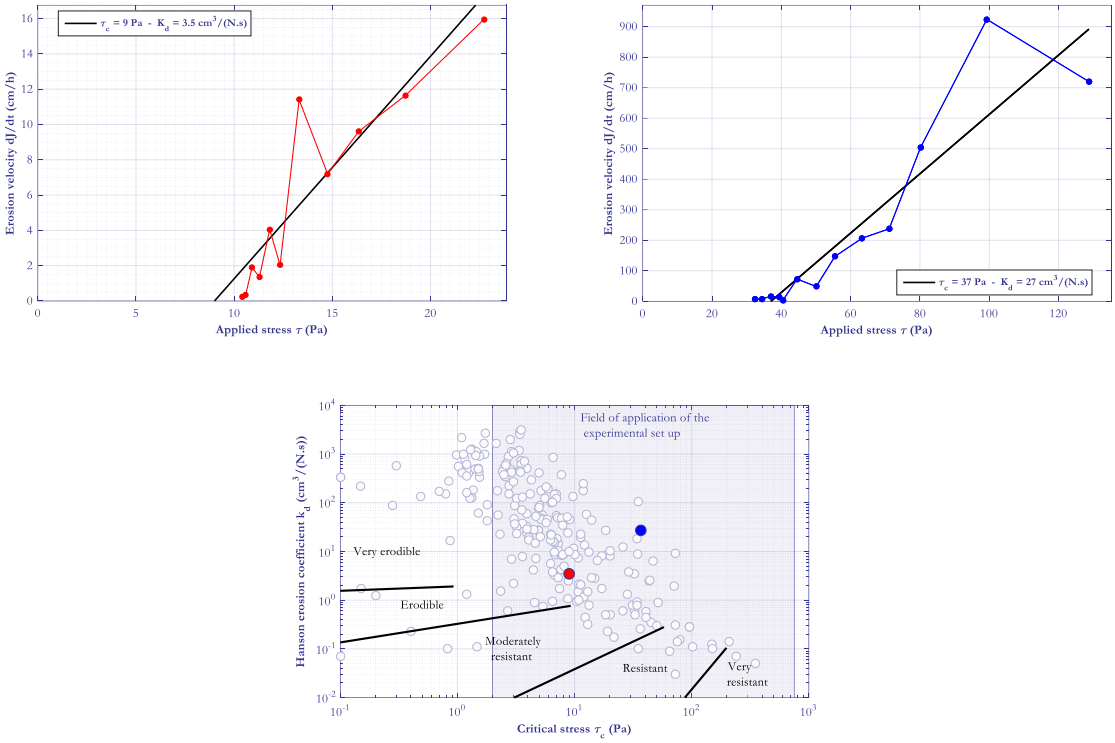
Picture 9. Sample SII_E2_B (on the left) and SIV_E1_A (on the right) after tests.

Several authors of the literature propose nonlinear erosion laws [3]. But faced with the sensitivity of these models to their calibration method (due to their large number of parameters), the current state of the art recommends staying on linear models [7].

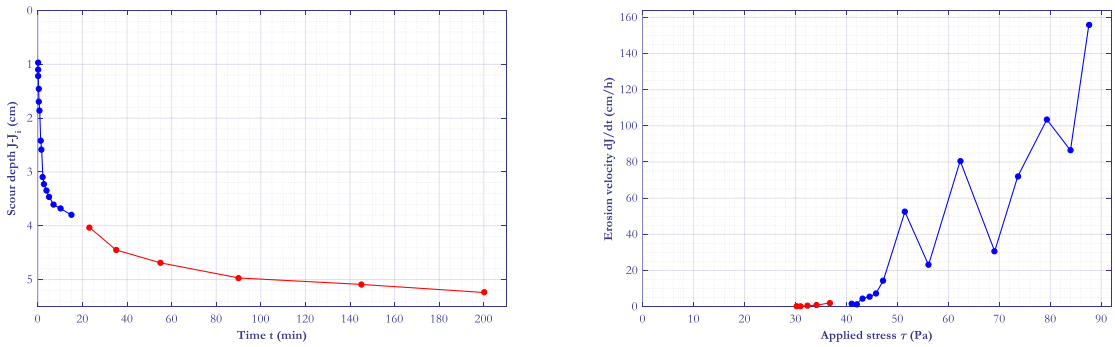
Considering these remarks and the inseparable character of these mechanisms, a two-phase modelling (bi-linear according to hydraulic stress) of the tests presenting a non-linear erosion law was used (Picture 10 and Picture 11). The first part of the test (blue in the figures) correspond to characteristic at high hydraulic loading, and better represent kinetic of erosion during overflow, usually at high shear stress. The second part (red) better represent the condition of initiation (in case of low loading) and termination of the erosion process.

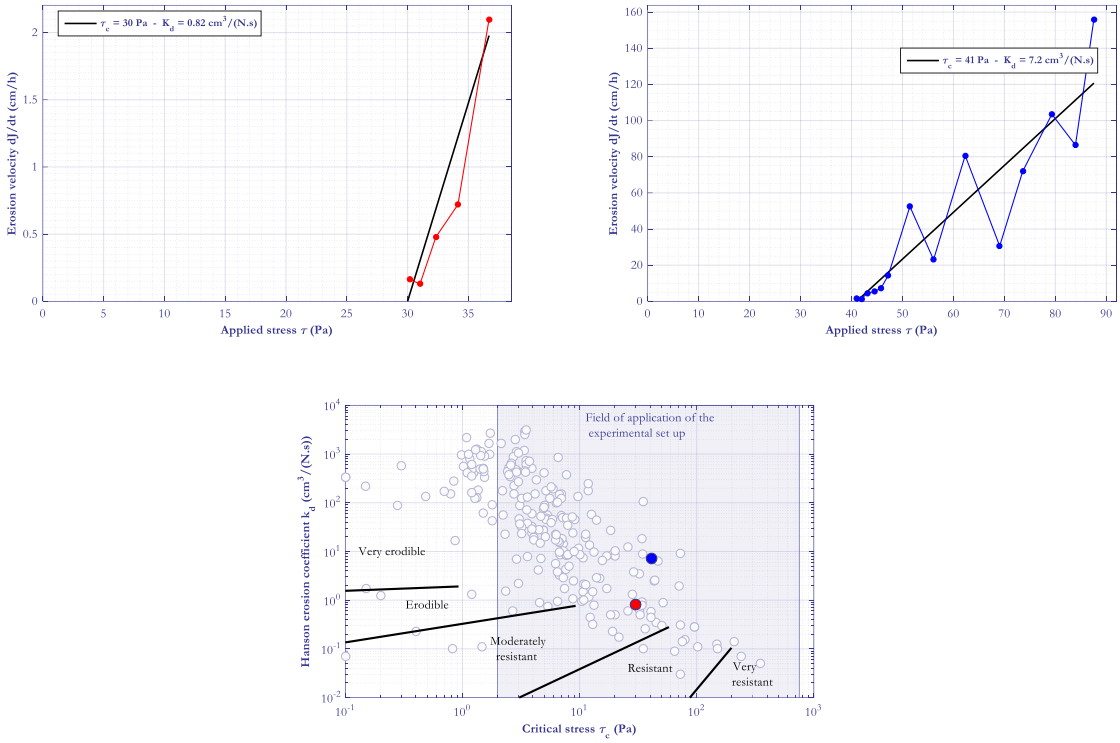






Picture 10. Modelling of test SII_E2_B. Top left: scour depth measurements. Top right: strain/erosion rate deduced from the test. Medium: linear modelling of the test by phase (first phase on the right and second phase on the left). Bottom: comparison of the results from phases 1 and 2 in the Hanson classification.





Picture 11. Modelling of test SXII_E1_A. Top left: scour depth measurements. Top right: strain/erosion rate deduced from the test. Medium: linear modelling of the test by phase (first phase on the right and second phase on the left). Bottom: comparison of the results from phases 1 and 2 in the Hanson classification.

6 Discussions

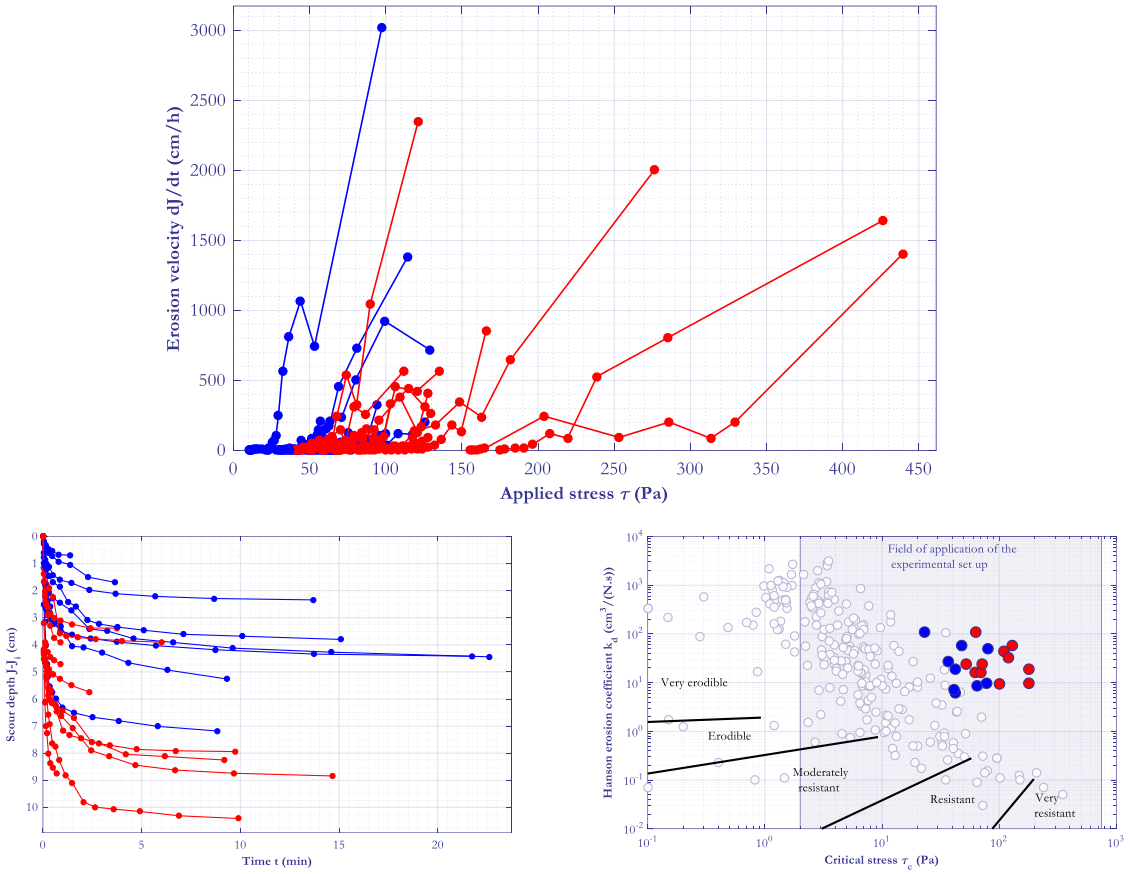
6.1 Influence of test and modeling parameters

6.1.1 Hydraulic load

The apparent diversity of the samples resistance impeded to test all samples using a same hydraulic load. To limit the number of different load, only two were used.

The geophy*Consult* experience shows that the hydraulic load slightly influences the results of the test (modification of the predominant erosion mechanisms, erosion of more layers of potentially heterogeneous soil under high load...).

Nevertheless, on this test campaign, the variability of the results seems much greater than the uncertainty linked to the variability of the hydraulic load. The maximum scour depths were obtained with both low load and high load (see Picture 12). The results also show higher average critical stresses for the samples tested under high load, which is consistent with respect to the operator's feeling).



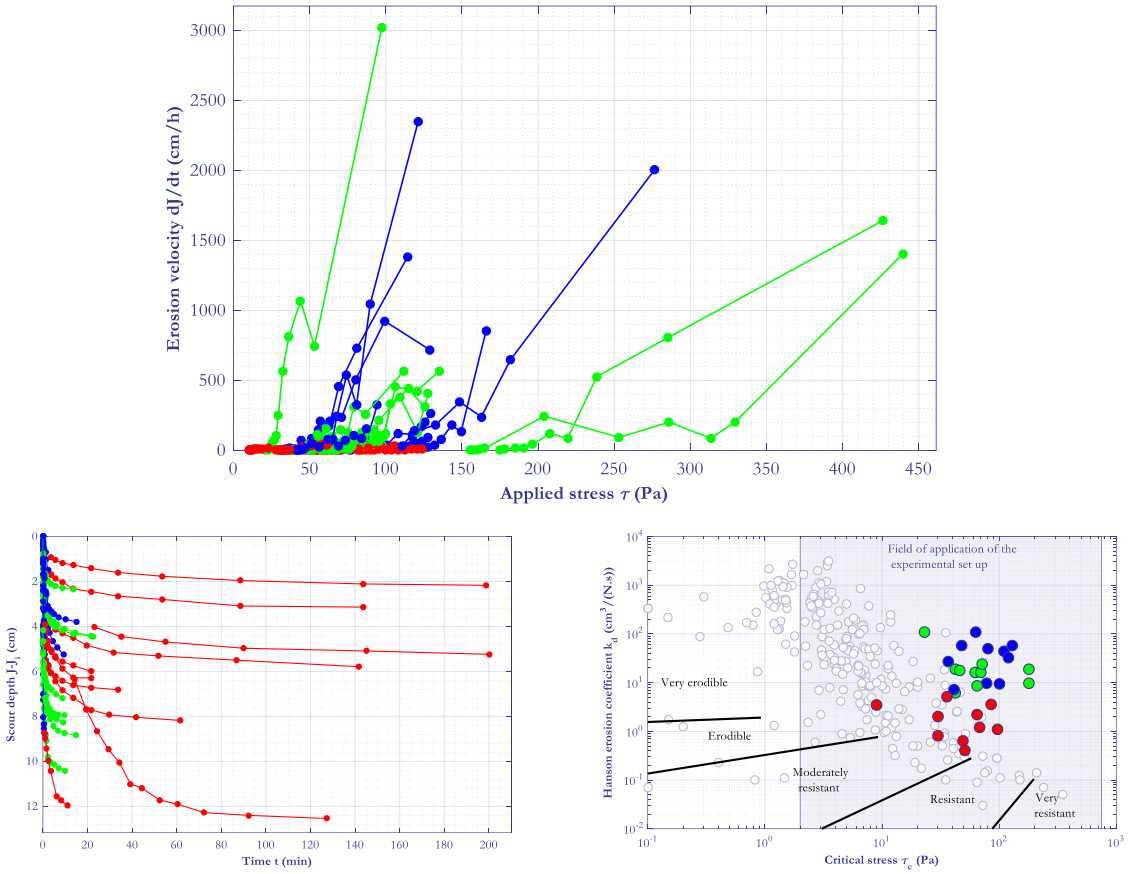
Picture 12. Comparison of the tests (first phase only) carried out at hydraulic loads of ~2 mCe (blue) and the tests carried out at hydraulic loads of ~8 mCe (red). Top: Erosion law dJ/dt=f(τ); bottom left: scour depth curves; bottom right: Hanson diagram.

6.1.2 Bilinear modeling

A clear trend was found by dissociating the results by soil behavior under test (linear or bi-linear erosion law). Regardless of the applied hydraulic load (Picture 13), it is clear that the results showing a bi-linear trend form two distinct scatter plot. The second phases of the tests show slightly lower critical stresses and significantly lower erosion coefficients than the first phases.

The monophasic erosion tests show similar results to those of the first phase of the two-phase erosion tests.

The influence of the vertical gradient of soil characteristics observed during sampling is difficult to dissociate from the bilinear behaviour of the soil resistance. However, the fact that either A and B samples exhibit this tendency show that depth is not the main explanation.



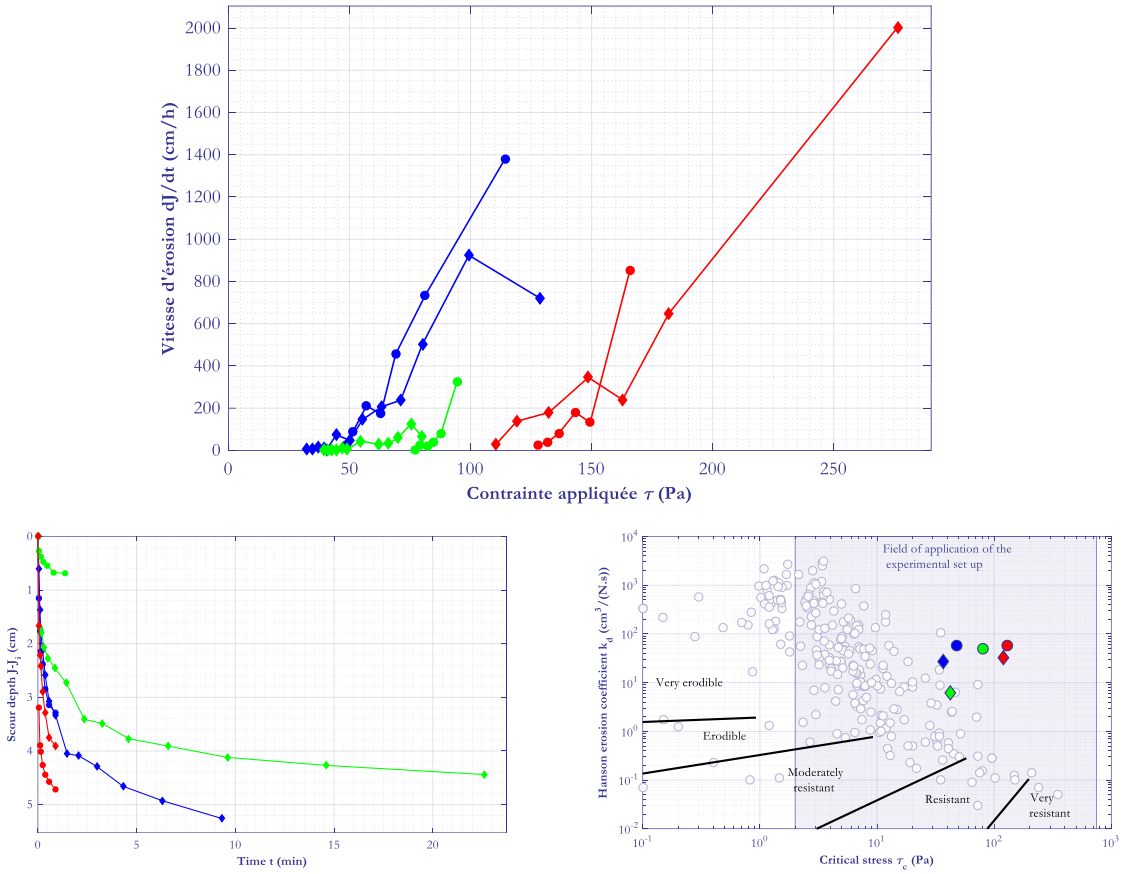
Picture 13. Comparison of modelling phases (samples "A" and "B"). In green, the tests modelled conventionally, using a single phase. In blue and in red the tests modelled by dissociating two phases: first phase in blue and second phase in red. Top: Erosion law dJ/dt=f(τ); bottom left: scour depth curves; bottom right: Hanson diagram.

6.1.3 Scour range retained

Note that for some tests, the initial erosion step, although very short (3 sec) lead to a deep scour depth (~4 cm). This is linked to the higher shear stress applied at the beginning of the tests but also to the possible weathering of the surface of the sample during sampling, transport, preparation and immersion phase (see §8). This first data point is not used for the modeling due to the large uncertainty on kinetics of erosion during this short impact and doubt on the representativity of the tested soil.

6.2 Site-specific influence factor

The results obtained on the samples "B" are close to the results obtained on the samples "A" taken at the same location. No clear distinction between the depth of sampling can be made.



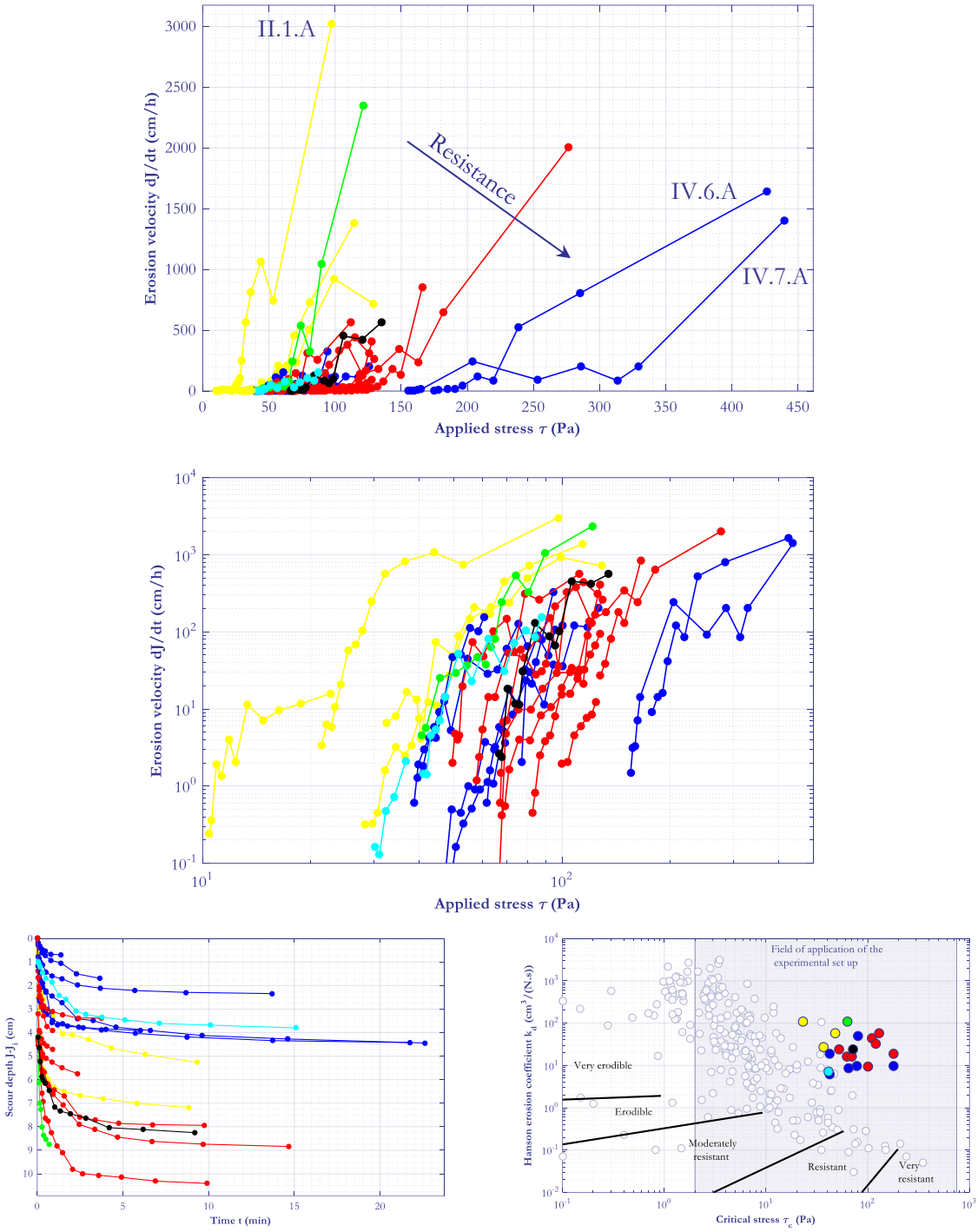
Picture 14. Comparison of results by sampling depth (samples "A" and "B", first phases only). Section II is shown in blue, section IV in green and section VI in red. Sampling depth A is represented by circles and sampling depth B by diamonds. Top: Erosion law dJ/dt=f(τ); bottom left: scour depth curves; bottom right: Hanson diagram.

In the same way, trends were sought in the results between the samples of different sections (see Picture 15). Only the first phase of the bilinear modeling is kept for the comparison in the Hanson diagram.

The scatter plot per section are relatively dispersed and overlap. k_d coefficient range from ~10 to ~100 cm3/(N.s) and τ_c from 20 to 200 Pa.

It can be noted that samples from section II (yellow) and X (green) show slightly lower critical shear stress (20-50 Pa) and similar or higher erosion coefficient than the rest of the tests.

In detail, it is observed that sample II.1.A is significantly less resistant and samples IV.6.A and IV.7.A significantly more resistant. On erosion law diagram on Picture 15, a less resistant soil is on the left part (high erosion velocity from low applied shear stress) and more resistant on the right, with flat slope (low erosion velocity even for high applied shear stress).



Picture 15. Comparison of the results by section (samples "A" and "B"). Section II is shown in yellow, section IV in blue, section VI in red, section X in green, section XI in black and section XII in cyan. Top: Erosion law dJ/dt=f(τ); bottom left: scour depth curves; bottom right: Hanson diagram.

6.3 Recommendations

For the two-phase tests it may be advisable to:

- retain only one or the other of the results according to the range of stress expected on the structure in the event of overflow. If the results is used to determine the breach modelling kinetic (in a model like WINDAM or HR Breach for example), the kinetic at large stress usually dominates and the value of k_d is crucial: the values of the first phase should be use. If initiation condition is investigated, for low loading events, phase 2 may be considered, especially for τ_c estimation.
- Only retain an average of the two models for comparison of the soil to existing databases.

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8 Appendix 1: The "Jet Erosion Test" implemented by geophy*Consult*

The « Jet Erosion Test » implemented at geophy*Consult*

1 Introduction

Overtopping occurs when the water level in a reservoir exceeds the height of crest of its closing structure. Water then flows over its downstream face. Unless this face is made of not erodible thin material, erosion starts and develops into successive small steps which behave like successive waterfalls that progressively grow and lead to a staircase shape which, under certain, conditions, is likely to lead ta a partial or total breach of the structure.
The Jet Erosion Test is aimed at reproducing this phenomenon in the laboratory for thin soils, by applying a permanent vertical water flows over the surface of a core extracted from the structure. It quantifies the erodibility of the tested soil, that is its resistance to erosion when it is subject to a perpendicular water flow.

Figure 1. Essai de JET en laboratoire (à gauche) et essai de JET *in-situ* (à droite).

Originally developed by Greg Hanson from USDA in the USA, it has been standardized in 2007 (see [1]). The apparatus has slightly evolved afterwards, until Hanson made rather well an

geophy*Consult*, Société par Actions Simplifiée au capital de 10 000 €
Siège social : 159, quai des Allobroges – 73 000 Chambéry – France
Laboratoire d'Essais d'Érosion : Sup'Agro – geophy*Consult* – Bâtiment 2 – 2, place Pierre Viala – 34 060 Montpellier cedex 02 – France
N° identification : 521 005 041 RCS Chambéry – Code APE : 7120B
N° SIRET : 521 005 041 00038 (siège) – 521 005 041 00020 (labo) – N° TVA intracommunautaire : FR 09 521 005 041
Mobile : +33 6 85 81 79 68 – Fax : +33 9 56 67 61 37
Courriel : administration@geophyConsult.com – Pages web : http://www.geophyConsult.com/

accomplished version of his system described in [1][2], which is now routinely used all over the world. geophy*Consult* started to commercialize this test in 2008.
The JET is now acknowledged by many teams throughout the world and thousands of tests have been carried out, leading to quite important a database of tests. Its simplicity and the fact it has become a worldwide reference have lead people to use not only to characterize the resistance to overtopping, but also to help optimize at which dose of cement or lime vulnerable to erosion surfaces are to be reinforced with soils mixing solutions. It is also commonly used for the commissioning of structures (by specifying that they have to present JET erosion parameters within predefined ranges), or for simulating the expected erosion of riverbanks, etc.

2 Experimental protocol

It is recommended to test intact soils, rather than reworked soils.

Intact soils are inserted into Protor moulds (if necessary, after having been cut) and paraffin sealed. Reworked soils are generally first dried up and cut to 5 mm, before they are rehumidified and inserted in a Proctor mould in which they are compacted at their original value.
The sample is then submerged into water during 10 min, before it is subject to a vertical water jet which is applied to the axis of the core. The water height of the applied jet is set to a value which is as close to the field hydraulic head as possible, as long as this value remains compatible with the practical constraints of the apparatus (min. applied hydraulic head = 2 Pa, max = 800 Pa) and as long as it enables to simultaneously trigger erosion and fully describe the erosion curve that is needed to lead to satisfactory modelization.

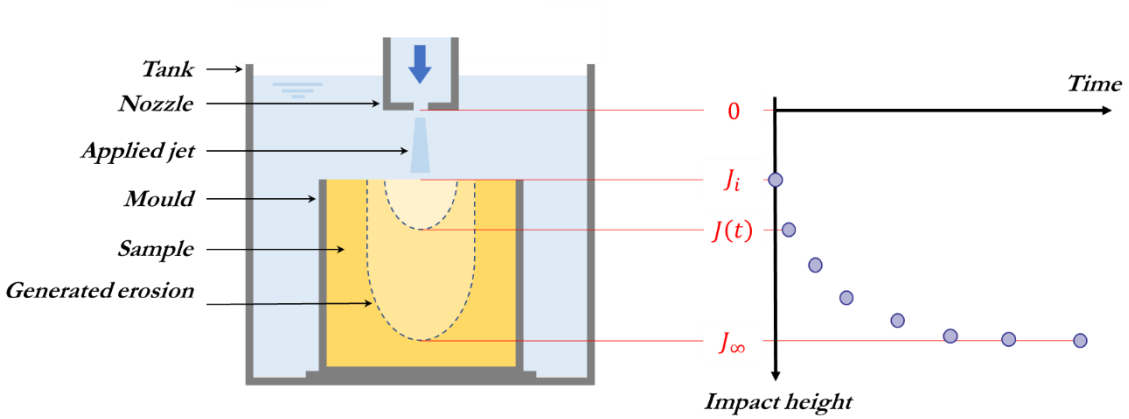

Figure 2. Test principle.

The scour depth J(t) is recorded all along the test and represented as a function of time t (Figure 2).

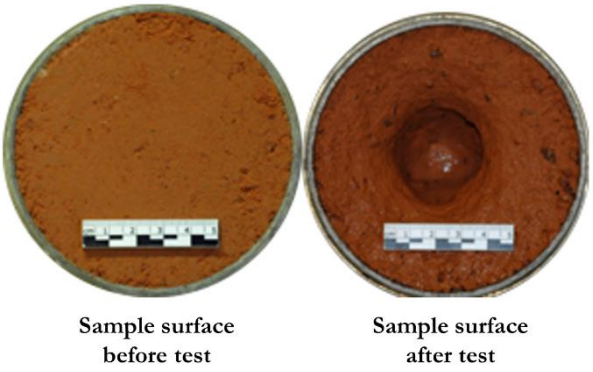

Figure 3. Sample surface before and after test.

3 Test modeling

Provided the applied jet generates a shear stress that is higher than the intrinsic critical shear stress of the sample (below which no erosion is triggered) the score depth evolves proportionally to the applied shear stress and follows a simple law:

$$\frac{dJ}{dt} = k_d(\tau - \tau_c),$$

where:

J is the jet impact heigh (m),
t is the time that last since the beginning of the test (s),
k_d is the Hanson erosion coefficient ($m^3/(N.s)$),
τ is the applied shear stress (Pa),
τ_c is the critical shear stress of the tested soil (Pa);

with:

$$\tau = \tau_0 \frac{{J_P}^2}{J^2} \qquad \tau_0 = C_f \rho {U_0}^2 \qquad J_p = C_d d_0 \qquad U_0 = \sqrt{2gh},$$

where:

τ_0 is the applied shear stress at t=0 (Pa),
C_f is a diffusion coefficient,
C_d is a friction coefficient,
ρ represents the water density,
g represents the gravity at the earth surface (m/s^2),
h is the applied hydraulic head (mCe).

The delivered erodibilty parameters τ_c (critical shear stress, below which no erosion occurs) and k_d (Hanson kinetic erosion coefficient) are calculated by adjusting the erosion law to the recorded scour depth over time. The applied shear stress at the soil/water interface is obtained *via* a centred scheme. These calculus lead to an uncertainty, which is higher at the beginning of the test (when the kinetic of the erosion process is higher than later) than in the end, when the sour depth gets close to its maximum J_∞.

As it is practically impossible to acquire data at regular shear stress steps, the selected best adjustment is sometimes different from the *a priori*.

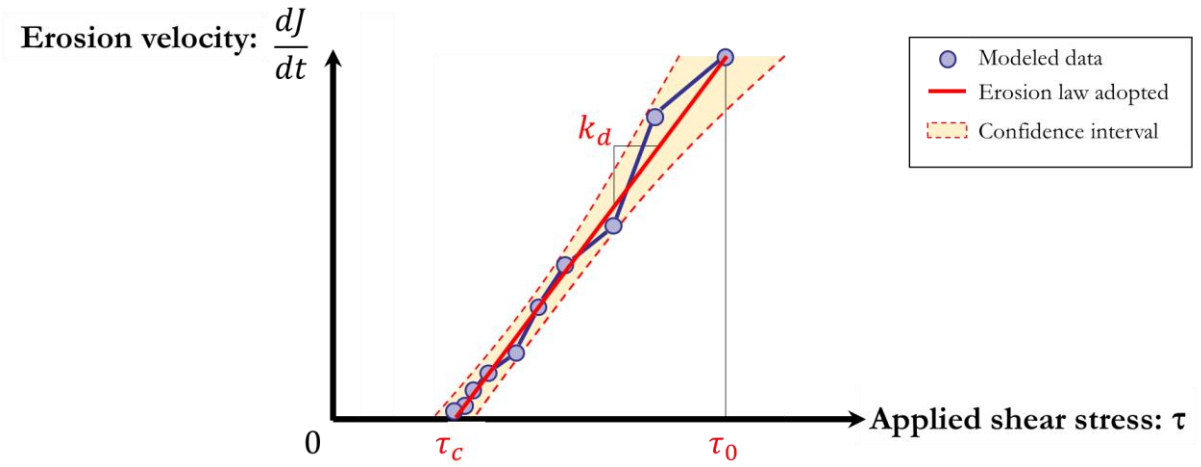

Figure 4. Ajustement des paramètres d'érosion (k_d, τ_c) sur la loi d'érosion.

geophy*Consult* delivers nominal values for k_d and τ_c and depicts curves that border all the possible values of those parameters within a 95% confidence interval, which is sometimes adapted to other value depending on the quality that can be assessed to the test.

4 Test interpretation

JET results can be used to:

- to quantitatively assess the resistance to erosion of a soil and compare it with other already tested soils,
- to model a breach by injecting the delivered values of τc and k_d in an erosion model like Windam (see [4] and http://go.usa.gov/cupCF) or HR-Breach and calculating breach hydrograms to be used in safety assessments,
- to estimate the expected erosion velocity in case the structure is subject to a given hydraulic head,
- to qualitatively assess the characteristics of the tested soil: is it homogeneous or stratified, does it comes apart or expands when submerged,

The quality of the test can be estimated by comparing the final scour depth to J_∞ and other experimental parameters.

5 References

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9 Appendix 2: Identification results

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client / MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2548**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : II.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Description : LIMON finement sableux brun, racines

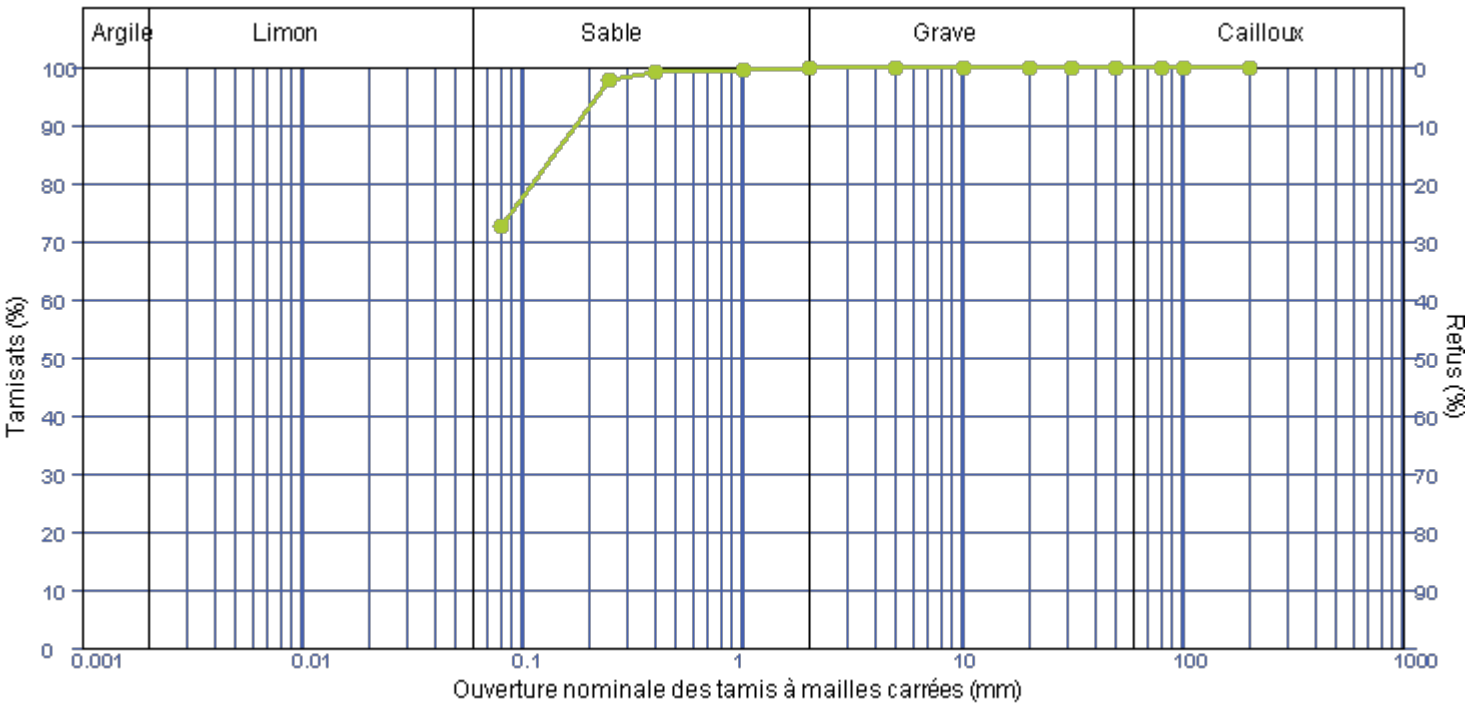
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : MAZOUNI Mohammed
Température : 105°C
Date essai : 03/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.7	99.5	99.1	97.6	72.6

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon **N° 20M-2548**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
Description : LIMON finement sableux brun, racines

Sondage : II.2.A
Profondeur : ( )
dm (mm) : 10 Wnat (%) : 15.6
Passant (%) à 80 µm de la fraction 0/D: 72.6

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C

Technicien : DEFOSSE Christophe
Date essai : 11/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

Facteurs correcteurs

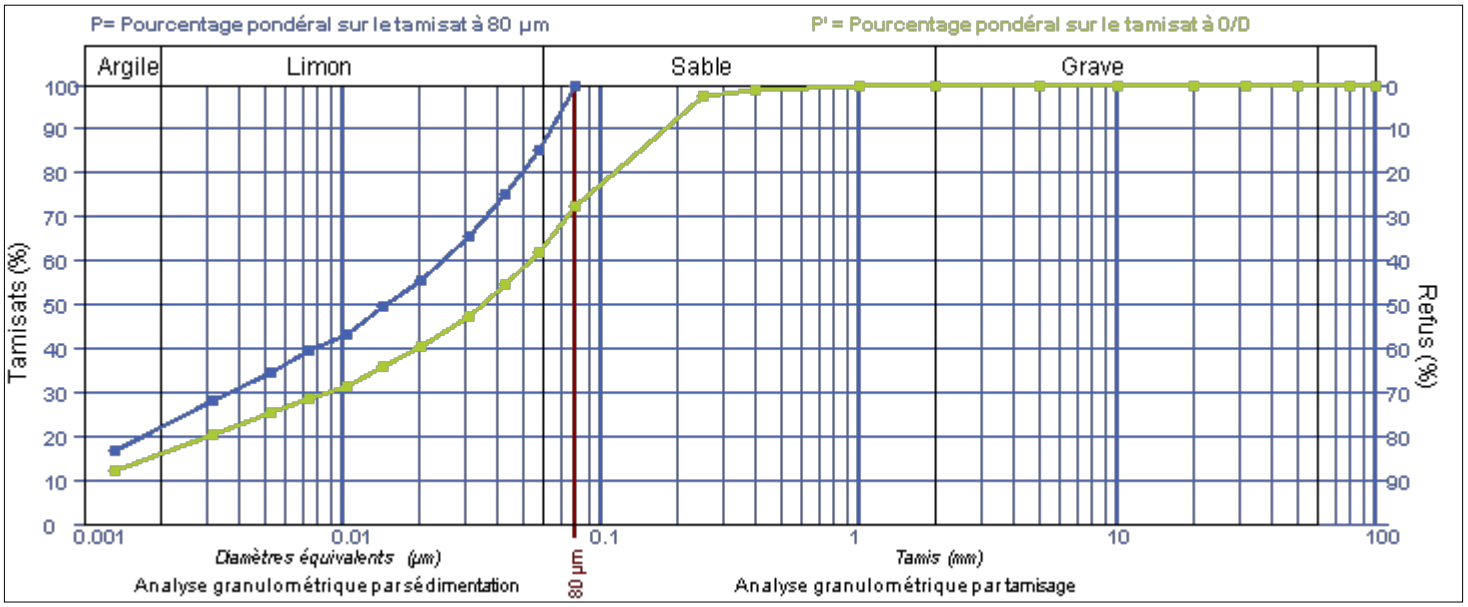
Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2)

57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0210	27.5	0.0005	58.5	85.1	61.7
1 min	60	1.0185	27.5	0.0005	42.6	75.2	54.6
2 min	120	1.0160	27.5	0.0005	31.0	65.3	47.4
5 min	300	1.0135	27.5	0.0005	20.1	55.5	40.3
10 min	600	1.0120	27.5	0.0005	14.4	49.5	36.0
20 min	1200	1.0105	27.2	0.0004	10.4	43.3	31.5
40 min	2400	1.0095	27.1	0.0004	7.4	39.3	28.5
80 min	4800	1.0085	26.3	0.0002	5.4	34.7	25.2
4H	14400	1.0070	25.4	0.0000	3.2	28.0	20.3
24H	86400	1.0040	26.0	0.0002	1.3	16.6	12.1



Passant (%) à 2 µm de la fraction 0/D mm : 15

Passant (%) à 2 µm de la fraction 80 µm : 21

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

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Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2647**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : II.2.B
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 31/07/20
dm (mm) : 10
Description : SABLE limoneux brun, racines

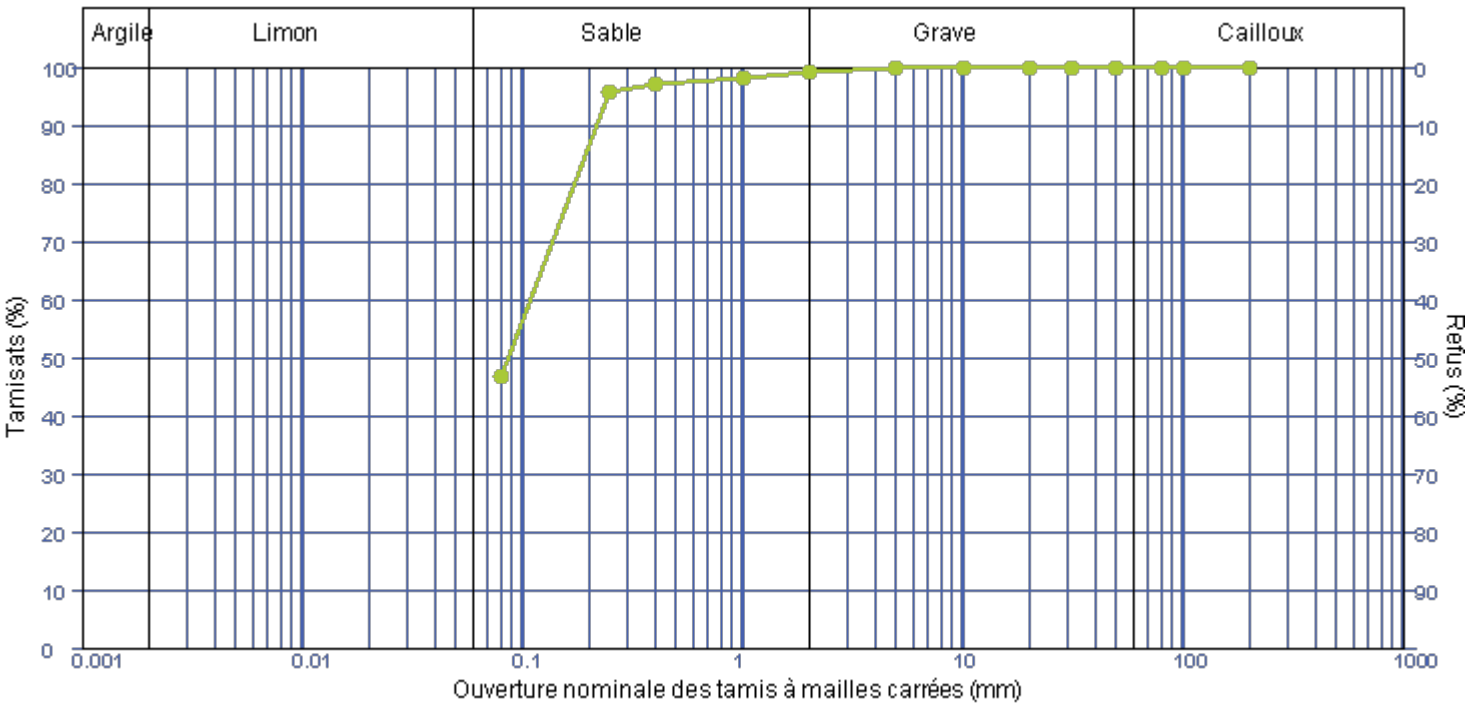
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : GINGER CEBTP
Température : 105°C
Date essai : 12/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.2	98.2	97.1	95.6	46.9

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon N° 20M-2647

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 31/07/20
Description : SABLE limoneux brun, racines

Sondage : II.2.B
Profondeur : ( )

dm (mm) : 10 Wnat (%) : 23.8
Passant (%) à 80 µm de la fraction 0/D: 46.9

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C

Technicien : DEFOSSE Christophe
Date essai : 12/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

Facteurs correcteurs

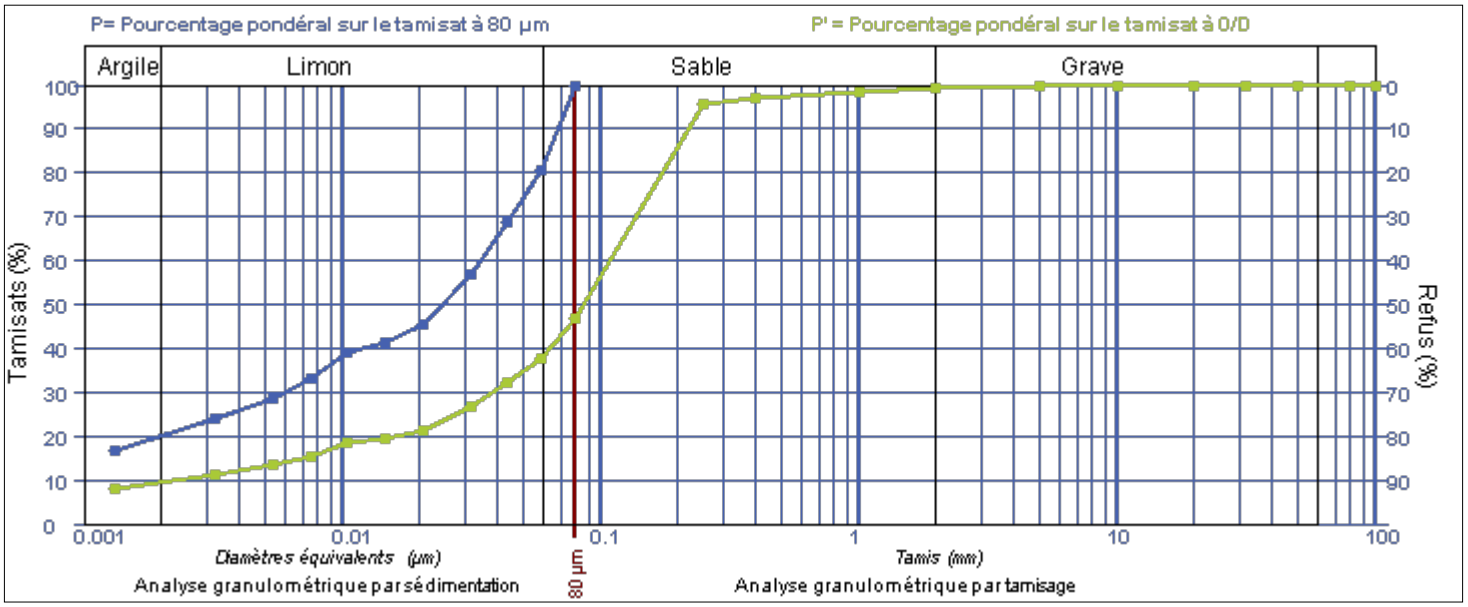
Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2)

57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0200	27.1	0.0004	59.5	80.8	37.9
1 min	60	1.0170	27.1	0.0004	43.5	68.9	32.3
2 min	120	1.0140	27.1	0.0004	31.8	57.1	26.8
5 min	300	1.0110	27.1	0.0004	20.7	45.2	21.2
10 min	600	1.0100	27.0	0.0004	14.8	41.2	19.3
20 min	1200	1.0095	26.9	0.0004	10.5	39.1	18.3
40 min	2400	1.0080	26.6	0.0003	7.6	32.9	15.4
80 min	4800	1.0070	25.9	0.0001	5.4	28.4	13.3
4H	14400	1.0060	25.1	0.0000	3.2	23.8	11.2
24H	86400	1.0040	26.0	0.0002	1.3	16.6	7.8



Passant (%) à 2 µm de la fraction 0/D mm : 9

Passant (%) à 2 µm de la fraction 80 µm : 19

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client / MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2549**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Description : LIMON argilo-sableux brun, racines

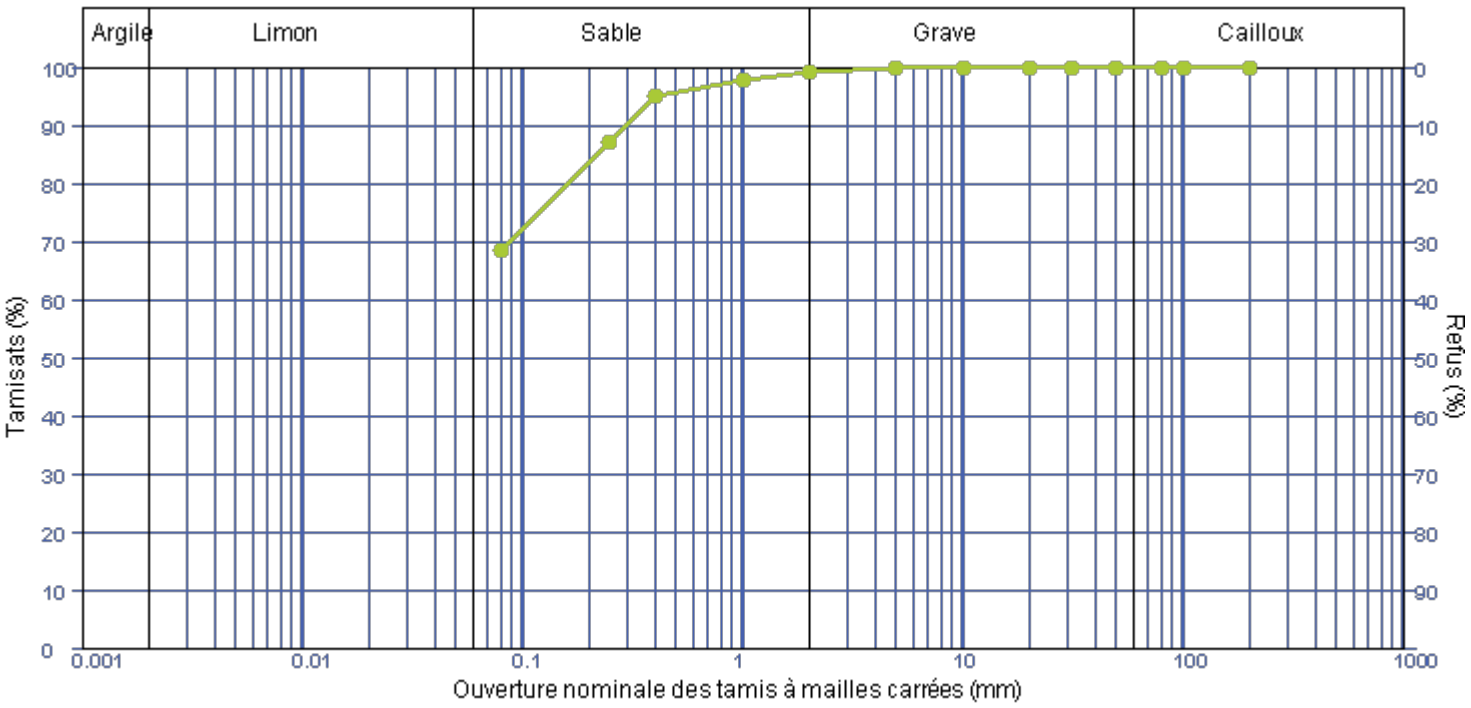
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : MAZOUNI Mohammed
Température : 105°C
Date essai : 04/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.2	97.8	94.9	87.1	68.4

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon **N° 20M-2549**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
Description : LIMON argilo-sableux brun, racines

Sondage : IV.2.A
Profondeur : ( )
dm (mm) : 10 Wnat (%) : 30.4
Passant (%) à 80 µm de la fraction 0/D: 68.4

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C
Technicien : DEFOSSE Christophe
Date essai : 10/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

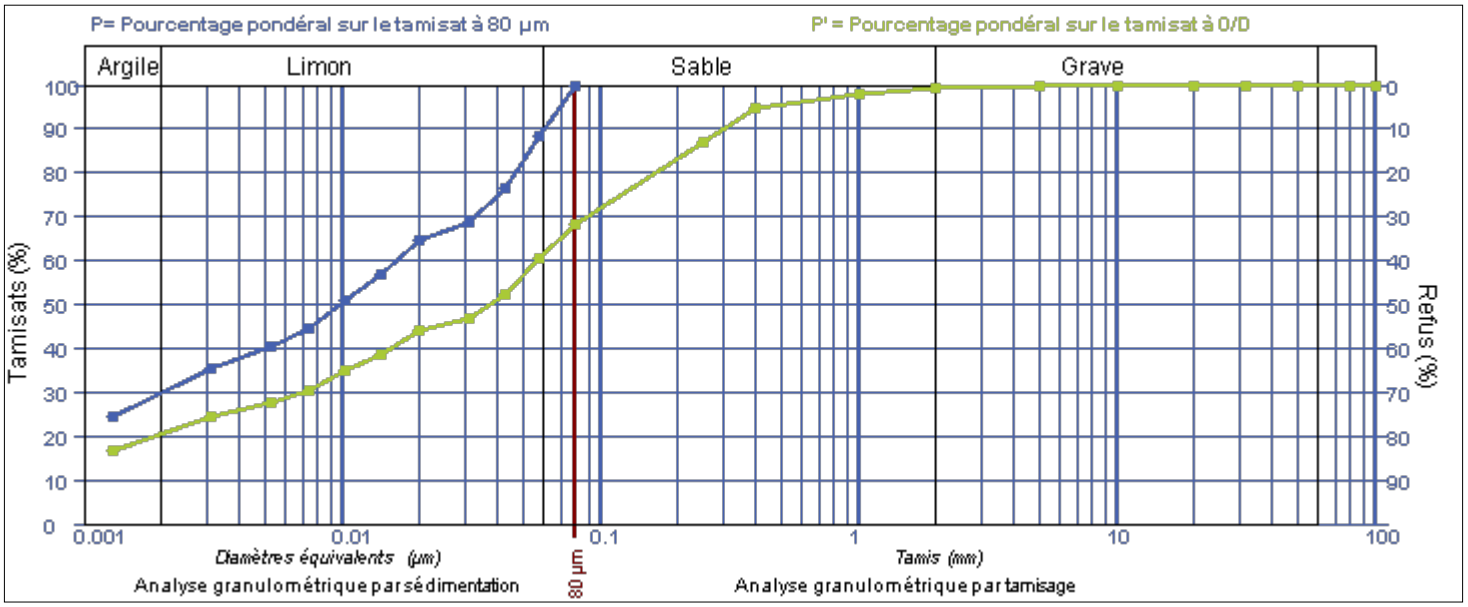
Facteurs correcteurs

Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2): 57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0220	26.7	0.0003	58.3	88.3	60.5
1 min	60	1.0190	26.7	0.0003	42.7	76.5	52.3
2 min	120	1.0170	26.7	0.0003	30.9	68.6	46.9
5 min	300	1.0160	26.7	0.0003	19.8	64.6	44.2
10 min	600	1.0140	26.6	0.0003	14.3	56.6	38.8
20 min	1200	1.0125	26.6	0.0003	10.3	50.7	34.7
40 min	2400	1.0110	26.2	0.0002	7.4	44.4	30.4
80 min	4800	1.0100	25.9	0.0001	5.3	40.2	27.5
4H	14400	1.0090	25.0	-0.0001	3.1	35.6	24.3
24H	86400	1.0060	26.0	0.0002	1.3	24.5	16.8



Passant (%) à 2 µm de la fraction 0/D mm : 20
Passant (%) à 2 µm de la fraction 80 µm : 29

Observations :

Chef de service laboratoire
Thierry LIPPLER

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client / MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2648**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.2.B
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 31/07/20
dm (mm) : 10
Description : LIMON argileux grisâtre

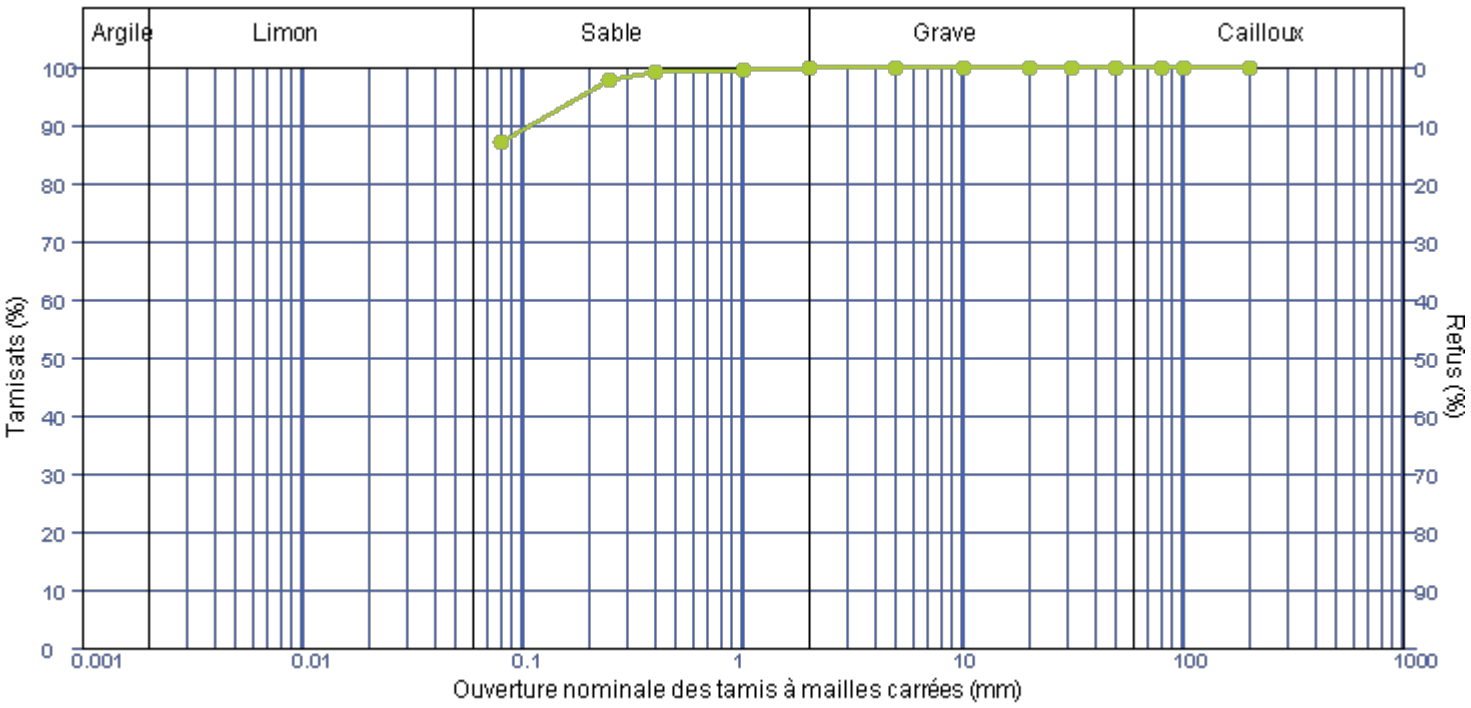
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : GINGER CEBTP
Température : 105°C
Date essai : 12/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.8	99.6	99.1	97.7	87.0

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon **N° 20M-2648**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 31/07/20
Description : LIMON argileux grisâtre

Sondage : IV.2.B
Profondeur : ( )

dm (mm) : 10 Wnat (%) : 31.9
Passant (%) à 80 µm de la fraction 0/D: 87.0

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C

Technicien : DEFOSSE Christophe
Date essai : 11/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

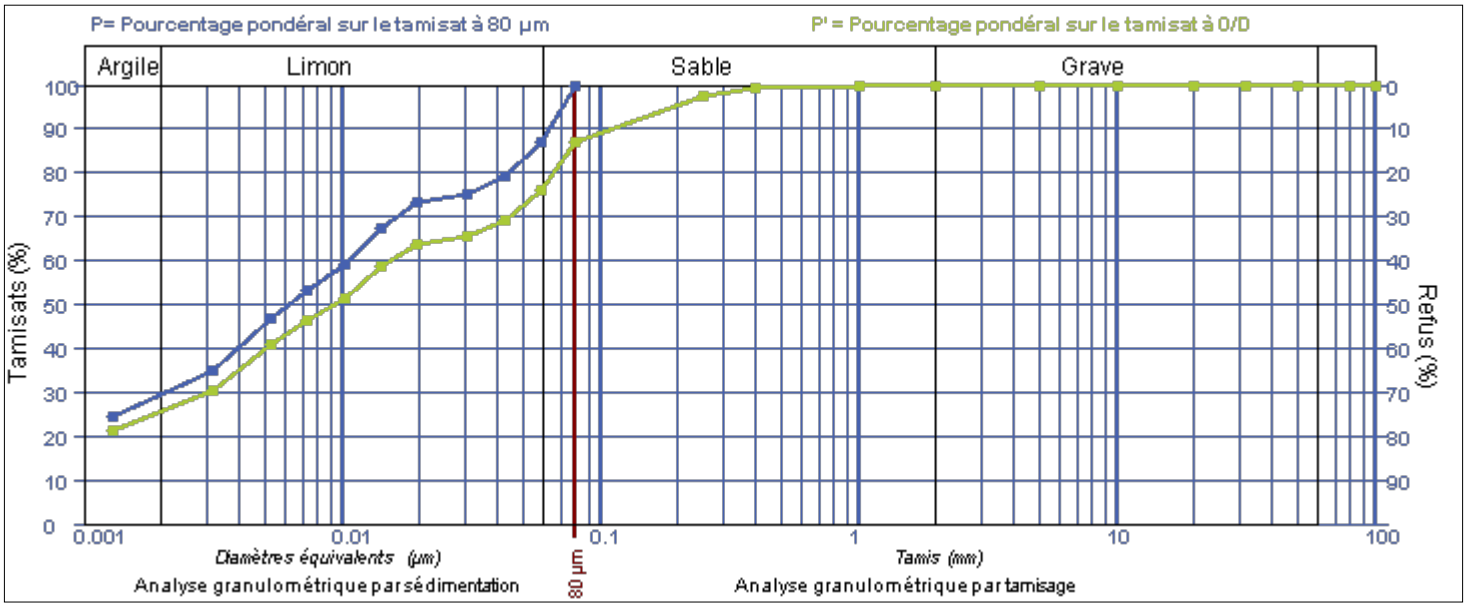
Facteurs correcteurs

Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2): 57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0220	25.3	0.0000	59.2	87.2	75.8
1 min	60	1.0200	25.3	0.0000	42.9	79.3	69.0
2 min	120	1.0190	25.3	0.0000	30.7	75.3	65.5
5 min	300	1.0185	25.3	0.0000	19.5	73.3	63.8
10 min	600	1.0170	25.2	0.0000	14.1	67.3	58.6
20 min	1200	1.0150	24.9	-0.0001	10.2	59.2	51.5
40 min	2400	1.0135	24.7	-0.0001	7.3	53.1	46.2
80 min	4800	1.0120	24.3	-0.0002	5.3	46.9	40.8
4H	14400	1.0090	24.3	-0.0002	3.1	35.0	30.5
24H	86400	1.0060	26.1	0.0002	1.3	24.6	21.4



Passant (%) à 2 µm de la fraction 0/D mm : 25
Passant (%) à 2 µm de la fraction 80 µm : 29

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client / MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2551**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : VI.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 20
Description : LIMON finement sableux brun, racines

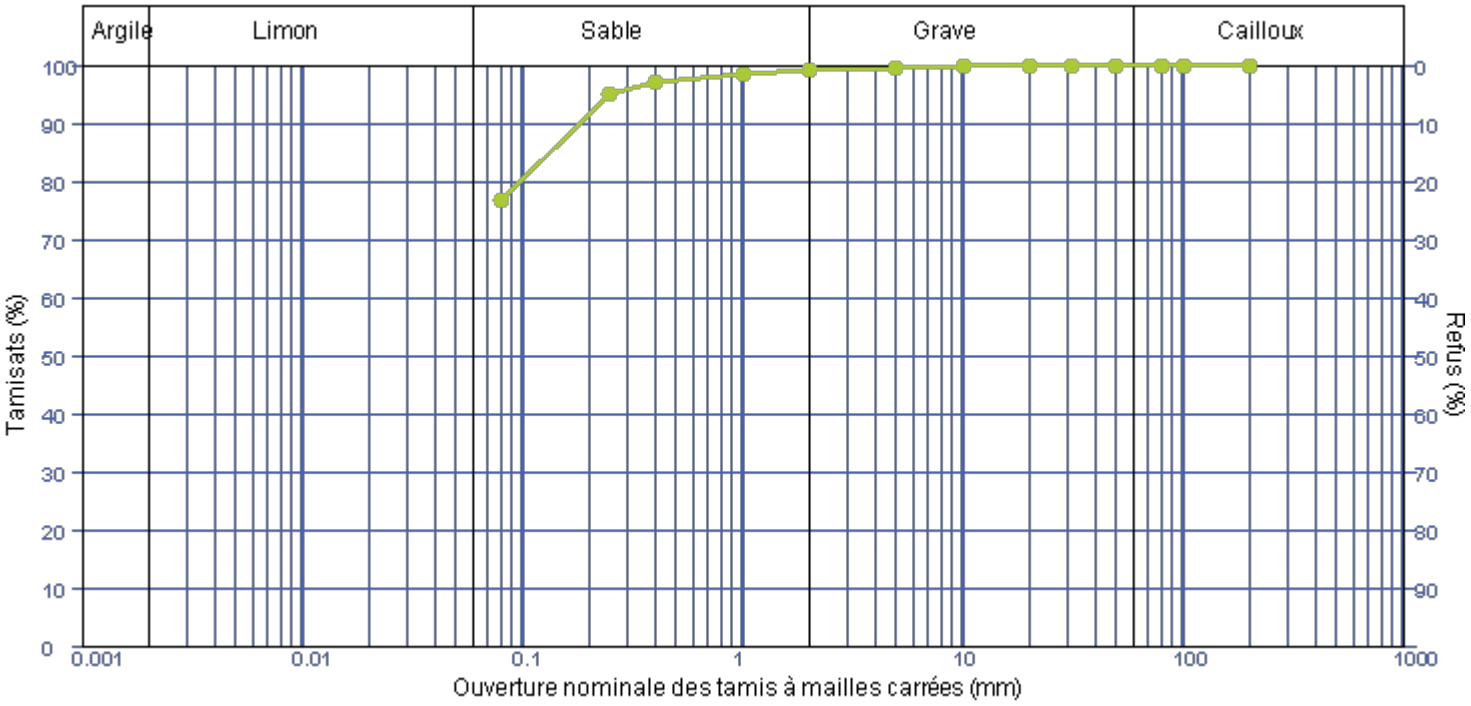
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : MAZOUNI Mohammed
Température : 105°C
Date essai : 11/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	99.8	99.6	99.1	98.3	97.0	95.1	76.8

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon **N° 20M-2551**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
Description : LIMON finement sableux brun, racines

Sondage : VI.2.A
Profondeur : ( )

dm (mm) : 20 Wnat (%) : 26.7
Passant (%) à 80 µm de la fraction 0/D: 76.8

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C

Technicien : DEFOSSE Christophe
Date essai : 11/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

Facteurs correcteurs

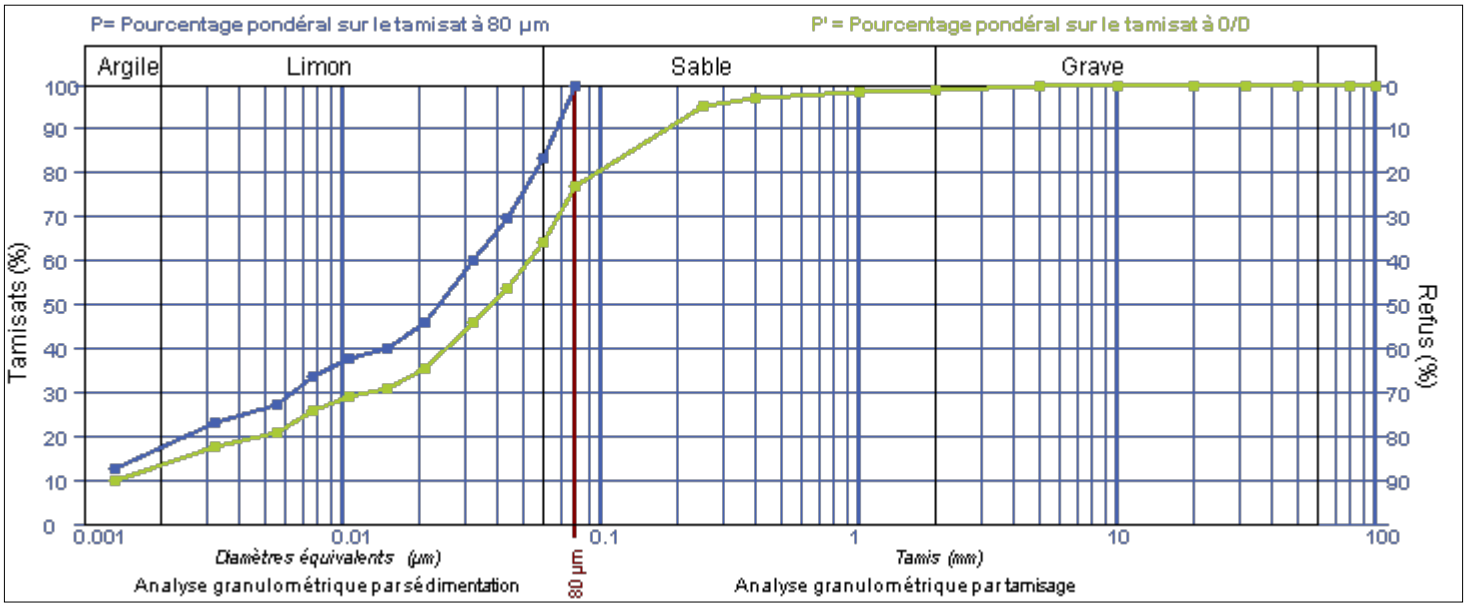
Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2)

57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0210	25.7	0.0001	59.7	83.5	64.2
1 min	60	1.0175	25.7	0.0001	44.0	69.7	53.5
2 min	120	1.0150	25.7	0.0001	31.9	59.8	46.0
5 min	300	1.0115	25.7	0.0001	20.9	46.0	35.3
10 min	600	1.0100	25.5	0.0001	15.1	39.9	30.7
20 min	1200	1.0095	25.3	0.0000	10.7	37.8	29.0
40 min	2400	1.0085	24.9	-0.0001	7.7	33.5	25.7
80 min	4800	1.0070	24.3	-0.0002	5.5	27.1	20.8
4H	14400	1.0060	24.3	-0.0002	3.2	23.2	17.8
24H	86400	1.0030	26.1	0.0002	1.3	12.8	9.8



Passant (%) à 2 µm de la fraction 0/D mm : 13

Passant (%) à 2 µm de la fraction 80 µm : 16

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par tamisage à sec après lavage
Méthode d'essai selon NF P 94-056 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client / MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2552**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : VI.6.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Description : LIMON finement sableux brun, racines

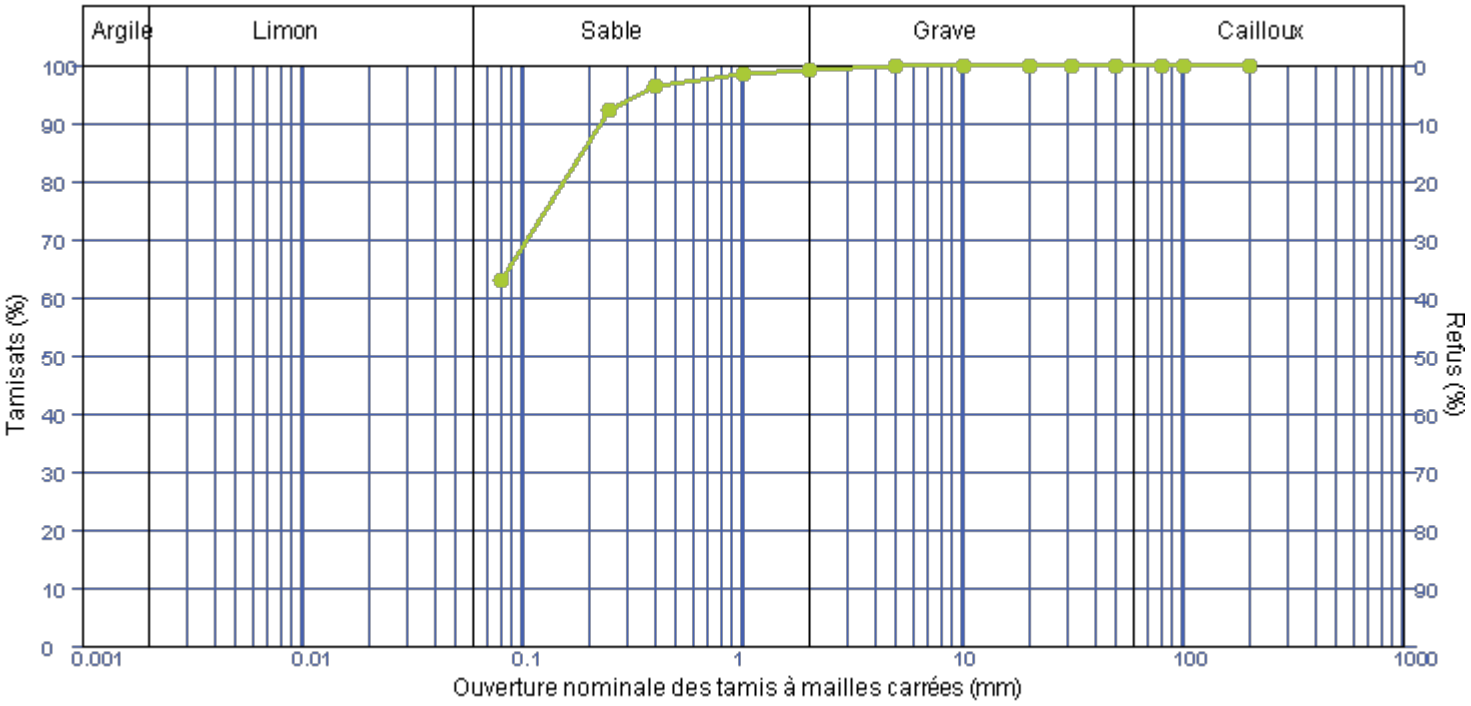
Informations sur l'essai

Mode de séchage : Etuvage
Technicien : MAZOUNI Mohammed
Température : 105°C
Date essai : 11/08/20

Analyse granulométrique sur 0/D mm

Tamis à mailles carrées (mm)	200 mm	100 mm	80 mm	50 mm	31.5 mm	20 mm	10 mm	5 mm	2 mm	1 mm	400 µm	250 µm	80 µm
Passant cumulé (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.7	99.1	98.3	96.5	92.3	62.9

Facteur d'uniformité Cu = *(N.D.)*
Facteur de courbure Cc = *(N.D.)*
Facteur de symétrie Cs = *(N.D.)*



Observations :

Dérogation à la méthode d'essai: La fin du tamisage sur chaque tamis est determinée visuellement

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

ANALYSE GRANULOMÉTRIQUE
Méthode par sédimentation
Méthode d'essai selon NF P 94-057 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Chargé d'affaire : THIERRY LIPPLER

Client / MO : SAS GEOPHYCONSULT
Demandeur / MOE : SAS GEOPHYCONSULT

Informations sur l'échantillon N° 20M-2552

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
(*) Prélevé par : CLIENT
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
Description : LIMON finement sableux brun, racines

Sondage : VI.6.A
Profondeur : ( )
dm (mm) : 10 Wnat (%) : 24.7
Passant (%) à 80 µm de la fraction 0/D: 62.9

Informations sur l'essai

Mode de séchage : Etuvage
Température : 105°C
Technicien : DEFOSSE Christophe
Date essai : 11/08/20

Paramètres du densimètre

H0 (cm):	10.0	h1 (cm):	14.7
H1 (cm):	2.7	Vd (cm3):	42

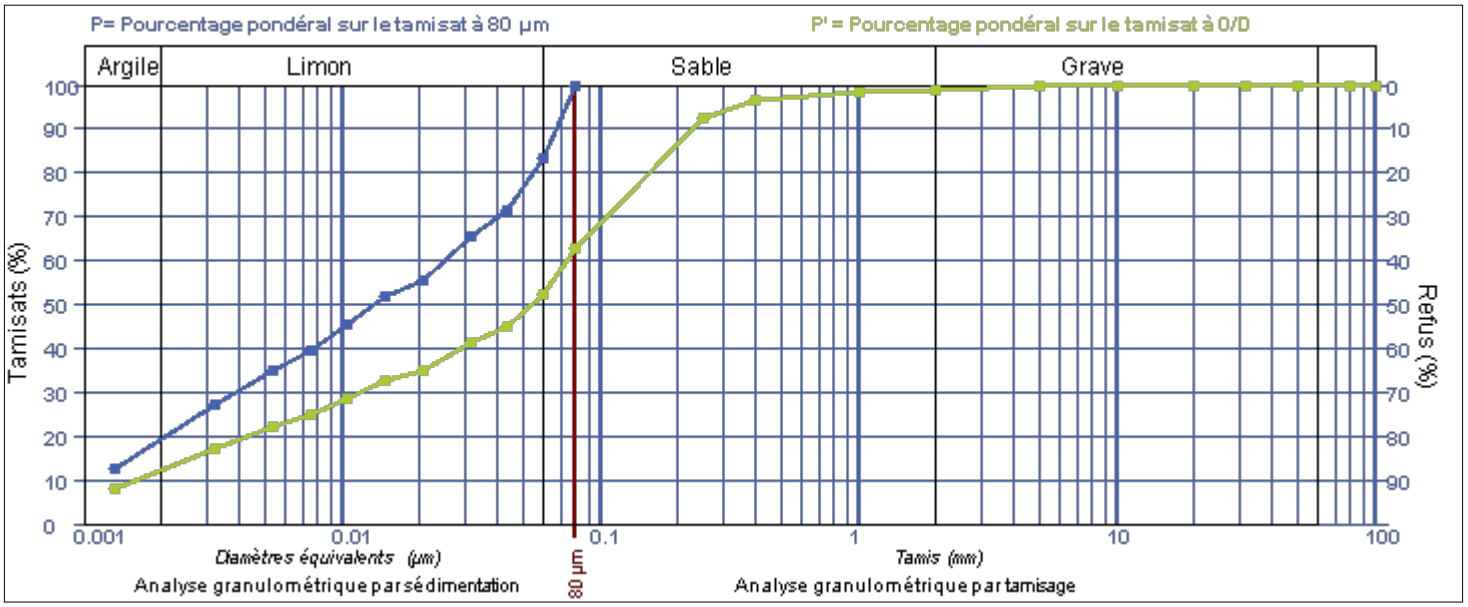
Facteurs correcteurs

Cm:	0.0006	Cd:	-0.0005

Section de l'éprouvette A (cm2): 57

Résultats:

Temps Lecture (hh:mm:ss)	Temps cumulés (s)	Lecture densimètre R	Température (°C)	Correction température Ct	Diamètre équivalent D (µm)	% passant sur la fraction 0/80 µm P (%)	% passant sur la fraction 0/D P' (%)
30 s	30	1.0210	25.4	0.0000	59.9	83.3	52.4
1 min	60	1.0180	25.4	0.0000	43.9	71.4	44.9
2 min	120	1.0165	25.4	0.0000	31.5	65.5	41.2
5 min	300	1.0140	25.4	0.0000	20.5	55.6	35.0
10 min	600	1.0130	25.3	0.0000	14.6	51.6	32.5
20 min	1200	1.0115	25.2	0.0000	10.5	45.6	28.7
40 min	2400	1.0100	24.8	-0.0001	7.6	39.4	24.8
80 min	4800	1.0090	24.3	-0.0002	5.4	35.0	22.0
4H	14400	1.0070	24.3	-0.0002	3.2	27.1	17.1
24H	86400	1.0030	26.1	0.0002	1.3	12.8	8.0



Passant (%) à 2 µm de la fraction 0/D mm : 11
Passant (%) à 2 µm de la fraction 80 µm : 18

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon N° 20M-2548

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : II.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Wnat (%) : 15.6
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

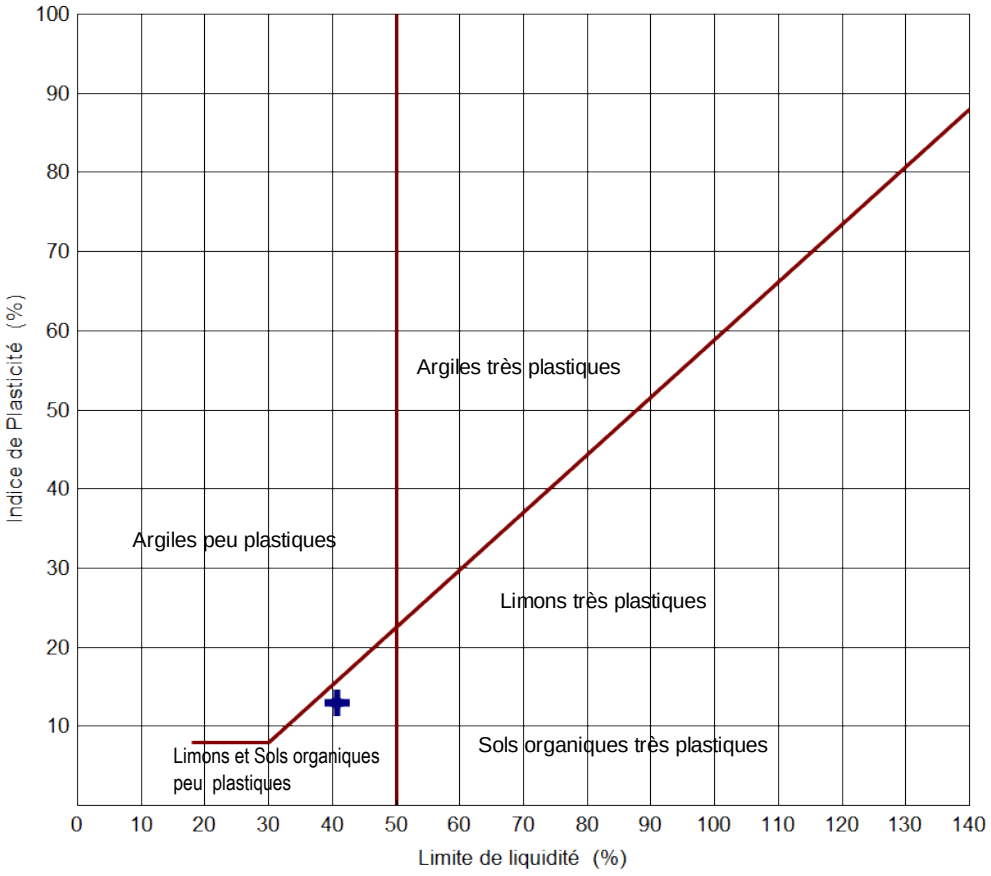
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	38.7
2	30	40.1
3	25	40.9
4	21	42.0
5	15	43.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	28.6
2	27.8
3	28.0

Limite de liquidité	W_L (%) = 41
Limite de plasticité	W_P (%) = 28
Indice de plasticité	I_P = 13
Indice de consistance	I_C = 1.95

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon N° 20M-2548

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : II.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Wnat (%) : 15.6
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

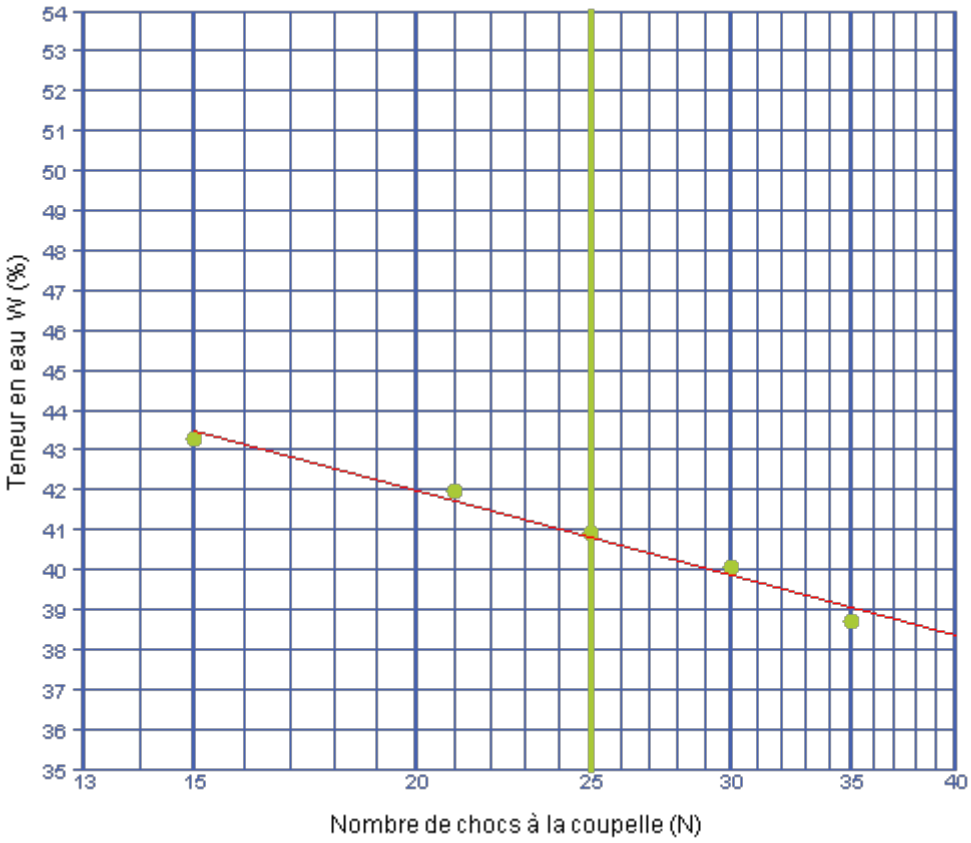
Résultats de l'essai

Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	38.7
2	30	40.1
3	25	40.9
4	21	42.0
5	15	43.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	28.6
2	27.8
3	28.0



Limite de liquidité	W_L (%) = 41
Limite de plasticité	W_P (%) = 28
Indice de plasticité	I_P = 13
Indice de consistance	I_C = 1.95

Observations :

Chef de service laboratoire
Thierry LIPPLER

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2549**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Wnat (%) : 30.4
Description : LIMON argilo-sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 11/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

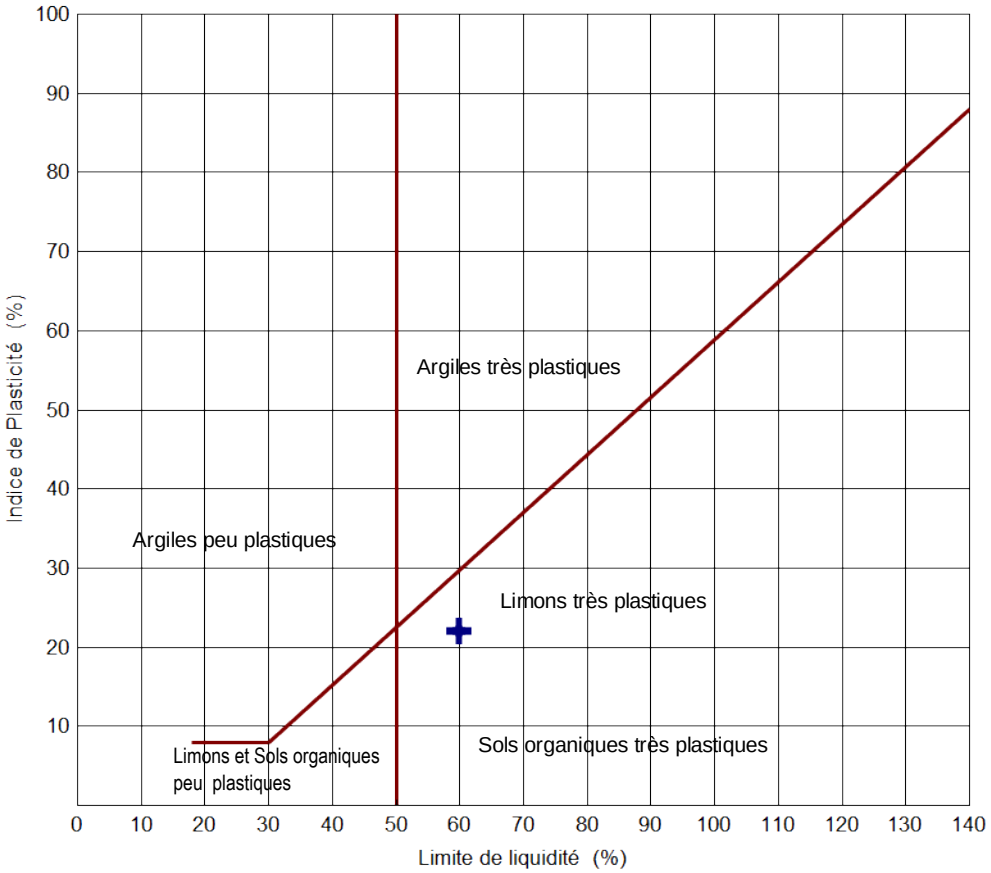
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	57.8
2	31	58.3
3	26	59.8
4	21	61.0
5	15	62.5

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	38.9
2	37.7
3	36.9

Limite de liquidité	W_L (%) = 60
Limite de plasticité	W_P (%) = 38
Indice de plasticité	I_P = 22
Indice de consistance	I_C = 1.35

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2549**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Wnat (%) : 30.4
Description : LIMON argilo-sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 11/08/20

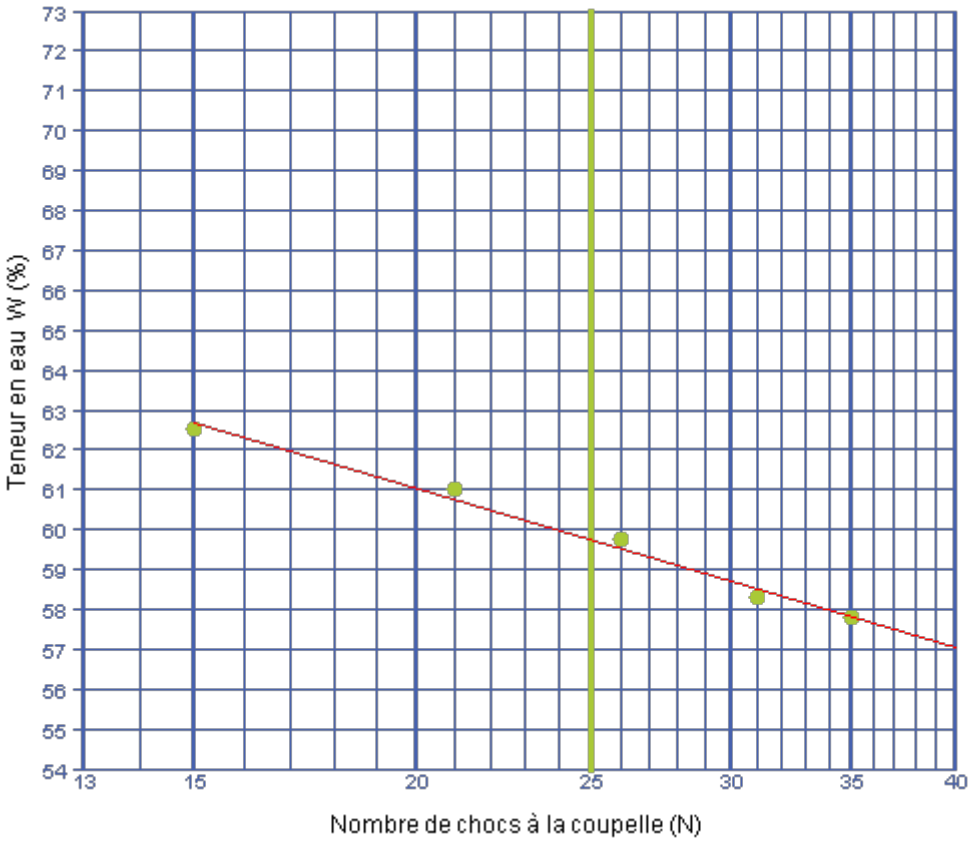
Résultats de l'essai

Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	57.8
2	31	58.3
3	26	59.8
4	21	61.0
5	15	62.5

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	38.9
2	37.7
3	36.9



Limite de liquidité	W_L (%) = 60
Limite de plasticité	W_P (%) = 38
Indice de plasticité	I_P = 22
Indice de consistance	I_C = 1.35

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon N° 20M-2550

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.6.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) :
Wnat (%) : 29.8
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

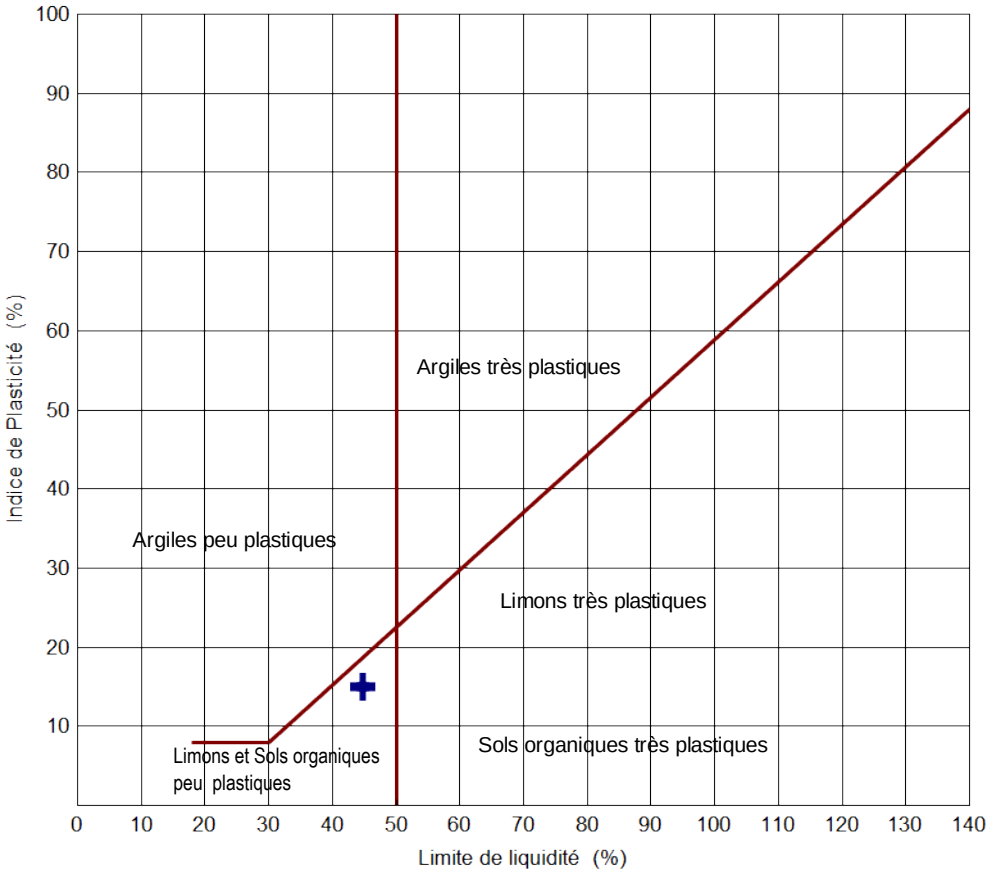
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	42.5
2	30	44.0
3	25	45.0
4	20	46.1
5	16	46.8

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	30.5
2	29.8
3	29.7

Limite de liquidité	W_L (%) = 45
Limite de plasticité	W_P (%) = 30
Indice de plasticité	I_P = 15

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2550**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : IV.6.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) :
Wnat (%) : 29.8
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

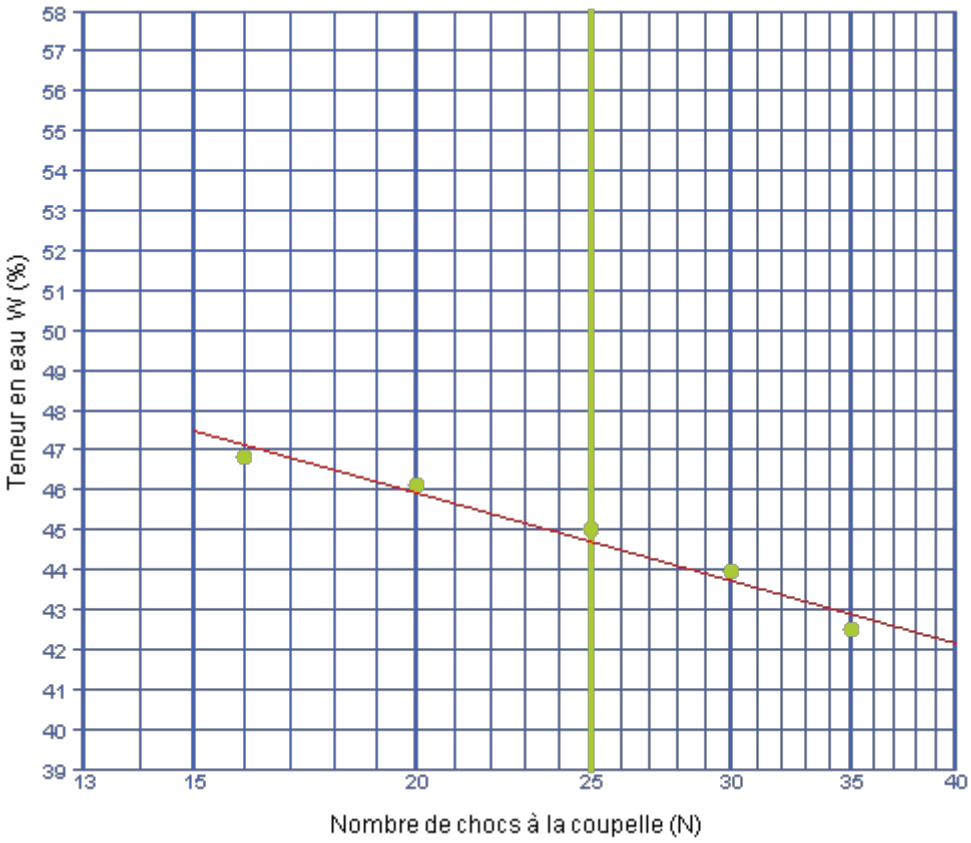
Résultats de l'essai

Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	42.5
2	30	44.0
3	25	45.0
4	20	46.1
5	16	46.8

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	30.5
2	29.8
3	29.7



Limite de liquidité	W_L (%) = 45
Limite de plasticité	W_P (%) = 30
Indice de plasticité	I_P = 15

Observations :

Chef de service laboratoire
Thierry LIPPLER

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2551**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : VI.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 20
Wnat (%) : 26.7
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 11/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

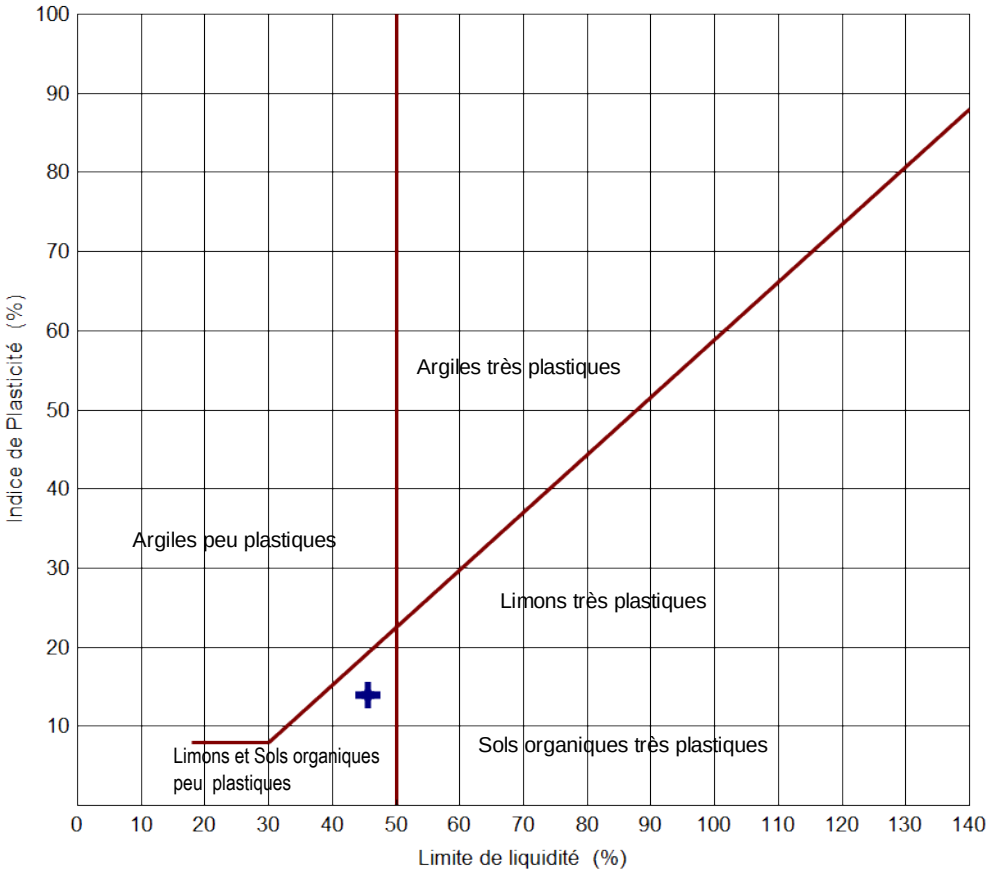
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	43.6
2	29	44.7
3	24	45.5
4	20	46.3
5	15	49.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	32.4
2	31.6
3	32.4

Limite de liquidité	W_L (%) = 46
Limite de plasticité	W_P (%) = 32
Indice de plasticité	I_P = 14
Indice de consistance	I_C = 1.38

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2551**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : VI.2.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 20
Wnat (%) : 26.7
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 11/08/20

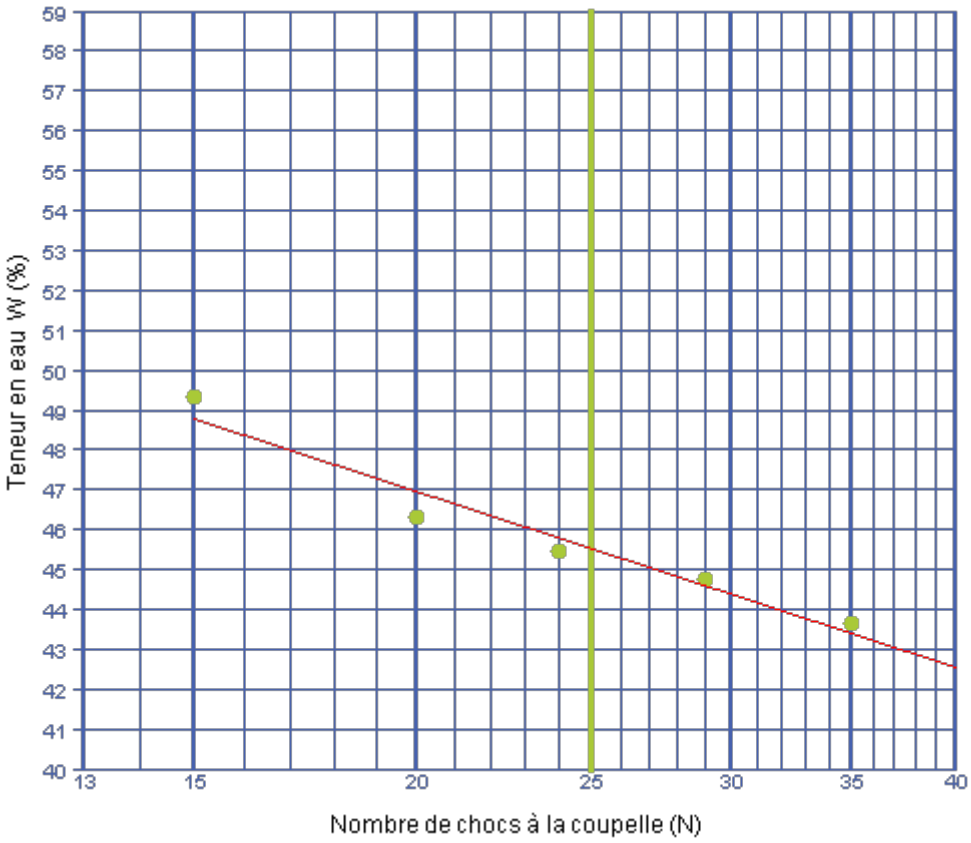
Résultats de l'essai

Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	43.6
2	29	44.7
3	24	45.5
4	20	46.3
5	15	49.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	32.4
2	31.6
3	32.4



Limite de liquidité	W_L (%) = 46
Limite de plasticité	W_P (%) = 32
Indice de plasticité	I_P = 14
Indice de consistance	I_C = 1.38

Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon N° 20M-2552

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : VI.6.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) : 10
Wnat (%) : 24.7
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 11/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

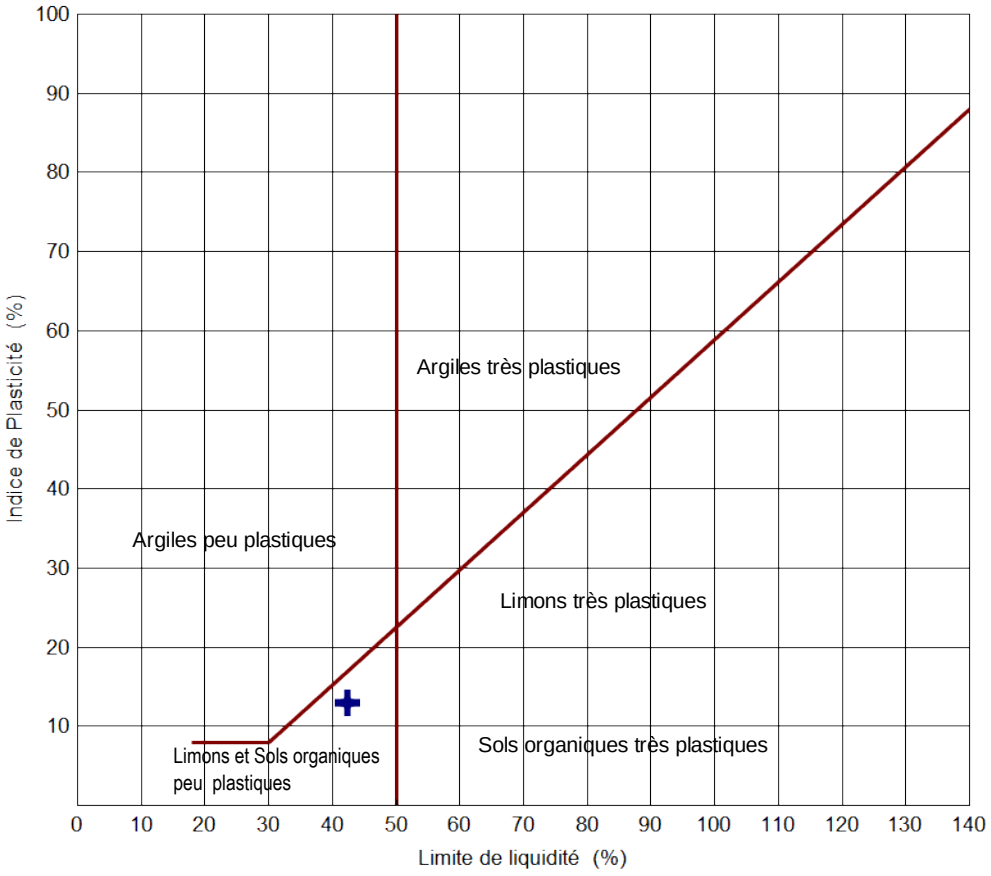
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	40.6
2	30	41.2
3	25	42.8
4	20	43.3
5	15	45.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	29.0
2	28.8
3	28.9

Limite de liquidité	W_L (%) = 42
Limite de plasticité	W_P (%) = 29
Indice de plasticité	I_P = 13
Indice de consistance	I_C = 1.33

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

Informations générales

N° dossier :	**CMO6.K2039.0001**	Client /MO :	SAS GEOPHYCONSULT
Désignation :	ESSAI LABO GEOPHYCONSULT		
Localité :	JACOU	Demandeur / MOE :	SAS GEOPHYCONSULT
Chargé d'affaire :	THIERRY LIPPLER		

Informations sur l'échantillon **N° 20M-2552**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement :	Pelle Mécanique	Sondage :	VI.6.A
(*) Prélevé par :	CLIENT	Profondeur : ( )	
Date prélèvement :	01/07/20		
Mode de conservation :	SAC		
Date de livraison :	23/07/20	dm (mm) : 10	Wnat (%) : 24.7
Description :	LIMON finement sableux brun, racines		

Informations sur l'essai

Mode de séchage :	Etuvage	Technicien :	DEFOSSE Christophe
Température :	105°C	Date essai :	11/08/20

Résultats de l'essai

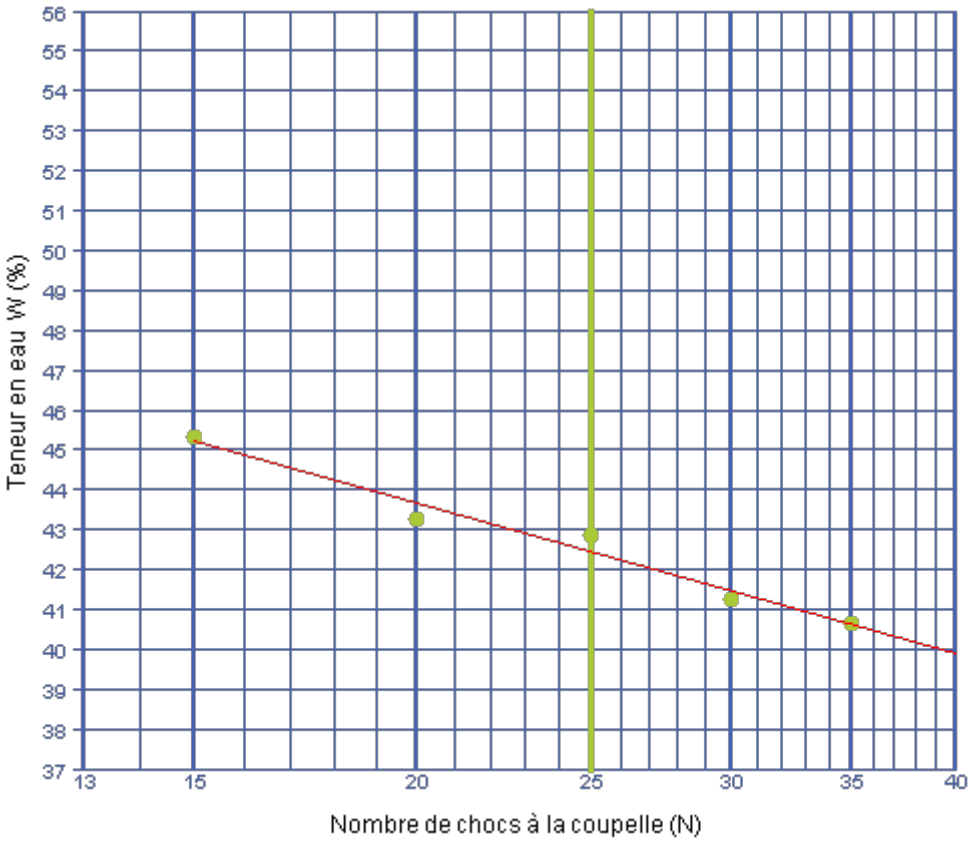
Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	40.6
2	30	41.2
3	25	42.8
4	20	43.3
5	15	45.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	29.0
2	28.8
3	28.9

Limite de liquidité	W_L (%) = 42
Limite de plasticité	W_P (%) = 29
Indice de plasticité	I_P = 13
Indice de consistance	I_C = 1.33



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2553**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : X.1.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) :
Wnat (%) : 21.8
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

Résultats de l'essai

Limite de Liquidité W_L (%)

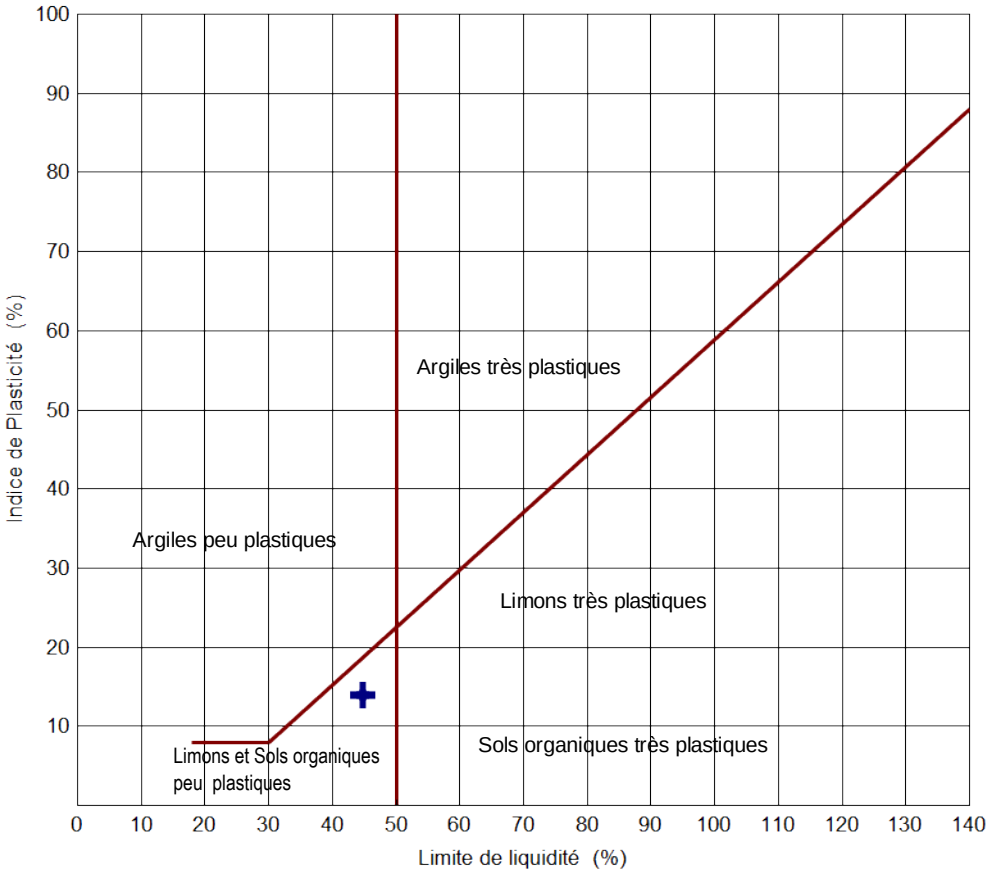
Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	45.3
2	29	42.4
3	25	43.9
4	20	46.3
5	15	47.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	31.6
2	30.3
3	30.5

Limite de liquidité	W_L (%) = 45
Limite de plasticité	W_P (%) = 31
Indice de plasticité	I_P = 14

DIAGRAMME DE CASAGRANDE



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

GINGER CEBTP

RAPPORT D' ESSAI

DÉTERMINATION DES LIMITES D'ATTERBERG
Limite de liquidité à la coupelle - Limite de plasticité au rouleau
Méthode d'essai selon NF P 94-051 (norme périmée)

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier : **CMO6.K2039.0001**
Client /MO : SAS GEOPHYCONSULT
Désignation : ESSAI LABO GEOPHYCONSULT
Localité : JACOU
Demandeur / MOE : SAS GEOPHYCONSULT
Chargé d'affaire : THIERRY LIPPLER

Informations sur l'échantillon **N° 20M-2553**

(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement : Pelle Mécanique
Sondage : X.1.A
(*) Prélevé par : CLIENT
Profondeur : ( )
Date prélèvement : 01/07/20
Mode de conservation : SAC
Date de livraison : 23/07/20
dm (mm) :
Wnat (%) : 21.8
Description : LIMON finement sableux brun, racines

Informations sur l'essai

Mode de séchage : Etuvage
Technicien : DEFOSSE Christophe
Température : 105°C
Date essai : 12/08/20

Résultats de l'essai

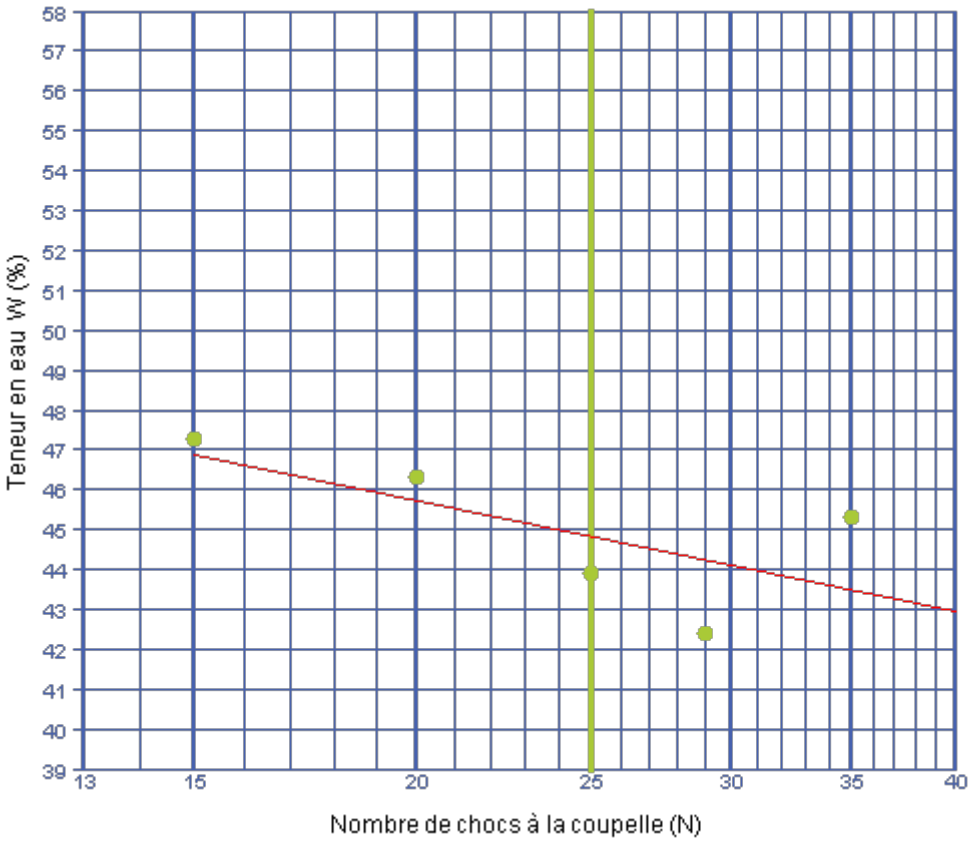
Limite de Liquidité W_L (%)

Mesure N°	Nb de chocs N	Teneur en eau W (%)
1	35	45.3
2	29	42.4
3	25	43.9
4	20	46.3
5	15	47.3

Limite de Plasticité W_P (%)

Mesure N°	Teneur en eau W (%)
1	31.6
2	30.3
3	30.5

Limite de liquidité	W_L (%) = 45
Limite de plasticité	W_P (%) = 31
Indice de plasticité	I_P = 14



Observations :

Chef de service laboratoire
Thierry LIPPLER

GINGER CEBTP Agence de JACOU - 12 RUE DES FRERES LUMIERE 34830 JACOU Tél:04.67.59.40.10 Fax:04.67.59.23.30 Email:cebtp.montpellier@groupeginger.com

RAPPORT D' ESSAI

ESSAI PROCTOR - Détermination des références de compactage NF P94-093

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier :	**CMO6.K2039.0001**	Client /MO :	SAS GEOPHYCONSULT
Désignation :	ESSAI LABO GEOPHYCONSULT		
Localité :	JACOU	Demandeur / MOE :	SAS GEOPHYCONSULT
Chargé d'affaire :	THIERRY LIPPLER		

Informations sur l'échantillon **N° 20M-2548**

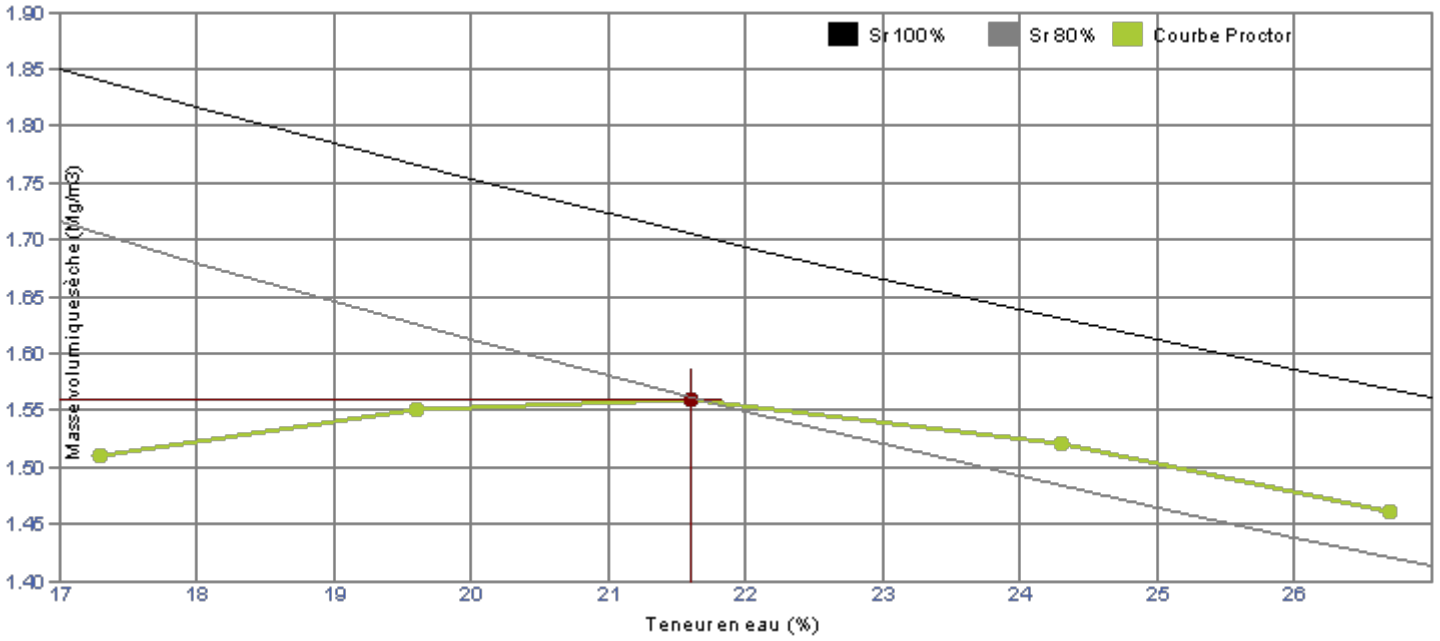
(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement :	Pelle Mécanique	Sondage :	II.2.A
(*) Prélevé par :	CLIENT	Profondeur :	( )
Date prélèvement :	01/07/20		
Mode de conservation :	SAC		
Date de livraison :	23/07/20		
Description :	LIMON finement sableux brun, racines	Wnat (%) :	26.7

Informations sur l'essai

Mode de séchage :	Etuvage	Température :	105°C	Technicien :	MAZOUNI Mohammed
Type de moule :	Moule Proctor			Date essai :	03/08/20
Dame - Energie de compactage :	A - Normale			Essai sur matériau :	Non traité
Fraction testée :	0/D mm			Liant(s) et dosage(s) :	
				Préparation du matériau :	Manuelle

Les courbes de saturation Sr 80% et Sr 100% sont tracées avec la masse volumique des particules solides de sol de 2.7 Mg/m3 (estimée)



Résultats sur les 5 moulages

Points expérimentaux	1	2	3	4	5		
Teneur en eau initiale (%)	21.6	26.7	24.3	17.3	19.6		
Teneur en eau traitée (%)							
ρd (Mg/m3)	1.56	1.46	1.52	1.51	1.55		

Teneur en eau optimale (%)	21.6
ρd optimale (Mg/m3)	1.56
Teneur en eau optimale corrigée (%)	
ρd corrigée (Mg/m3)	

Observations

NB: correction pour les matériaux comportant moins de 30% d'éléments de dimension supérieure à 20 m

Chef de service laboratoire
Thierry LIPPLER

RAPPORT D' ESSAI

ESSAI PROCTOR - Détermination des références de compactage NF P94-093

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier :	**CMO6.K2039.0001**	Client /MO :	SAS GEOPHYCONSULT
Désignation :	ESSAI LABO GEOPHYCONSULT		
Localité :	JACOU	Demandeur / MOE :	SAS GEOPHYCONSULT
Chargé d'affaire :	THIERRY LIPPLER		

Informations sur l'échantillon **N° 20M-2549**

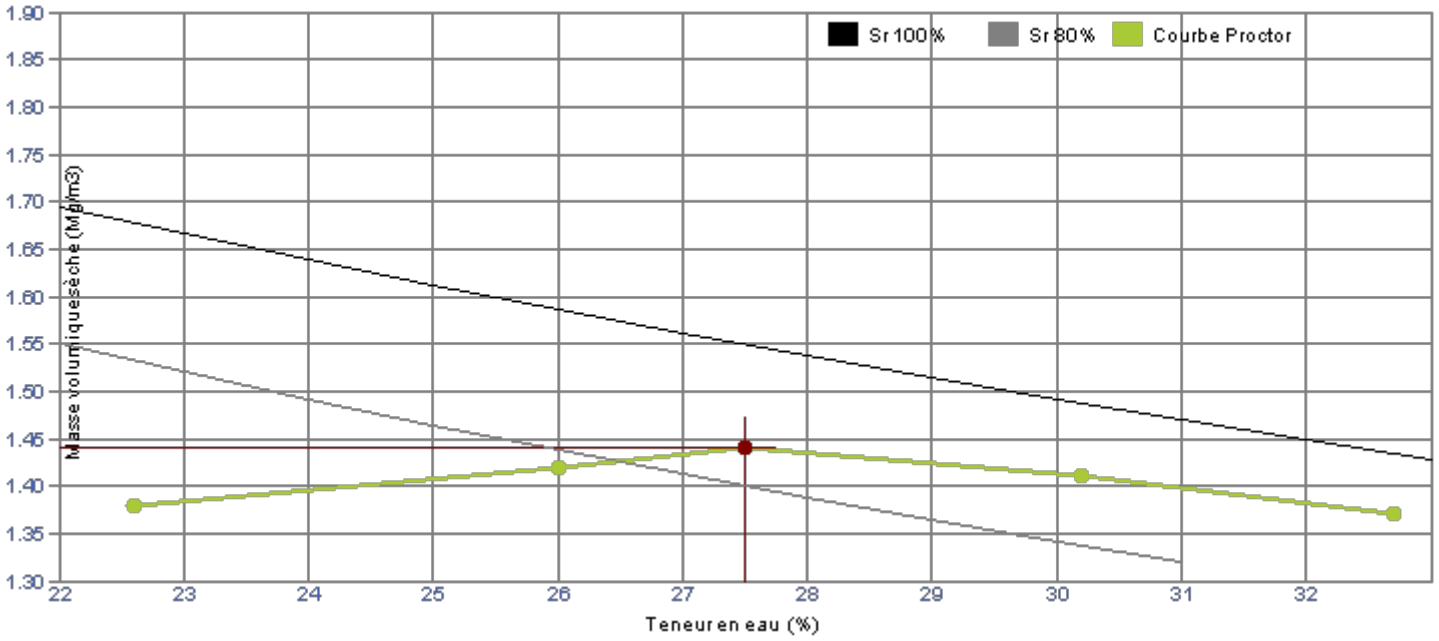
(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement :	Pelle Mécanique	Sondage :	IV.2.A
(*) Prélevé par :	CLIENT	Profondeur :	( )
Date prélèvement :	01/07/20		
Mode de conservation :	SAC		
Date de livraison :	23/07/20		
Description :	LIMON argilo-sableux brun, racines	Wnat (%) :	30.2

Informations sur l'essai

Mode de séchage :	Etuvage	Température :	105°C	Technicien :	MAZOUNI Mohammed
Type de moule :	Moule Proctor			Date essai :	04/08/20
Dame - Energie de compactage :	A - Normale			Essai sur matériau :	Non traité
Fraction testée :	0/D mm			Liant(s) et dosage(s) :	
				Préparation du matériau :	Manuelle

Les courbes de saturation Sr 80% et Sr 100% sont tracées avec la masse volumique des particules solides de sol de 2.7 Mg/m3 (estimée)



Résultats sur les 5 moulages

Points expérimentaux	1	2	3	4	5		
Teneur en eau initiale (%)	30.2	27.5	26.0	22.6	32.7		
Teneur en eau traitée (%)							
ρd (Mg/m3)	1.41	1.44	1.42	1.38	1.37		

Teneur en eau optimale (%)	27.5
ρd optimale (Mg/m3)	1.44
Teneur en eau optimale corrigée (%)	
ρd corrigée (Mg/m3)	

Observations

NB: correction pour les matériaux comportant moins de 30% d'éléments de dimension supérieure à 20 m

Chef de service laboratoire
Thierry LIPPLER

RAPPORT D' ESSAI

ESSAI PROCTOR - Détermination des références de compactage NF P94-093

GINGER CEBTP JACOU
12 RUE DES FRERES LUMIERE
34830 JACOU

Informations générales

N° dossier :	**CMO6.K2039.0001**	Client /MO :	SAS GEOPHYCONSULT
Désignation :	ESSAI LABO GEOPHYCONSULT		
Localité :	JACOU	Demandeur / MOE :	SAS GEOPHYCONSULT
Chargé d'affaire :	THIERRY LIPPLER		

Informations sur l'échantillon **N° 20M-2552**

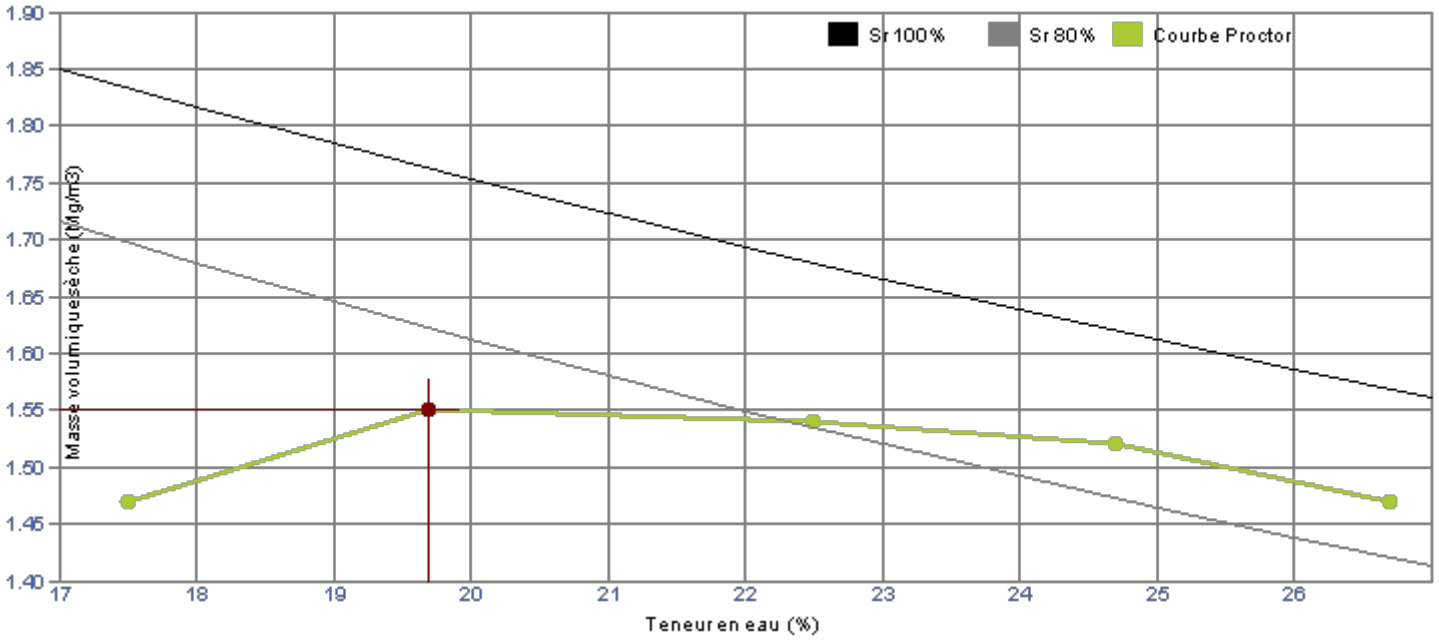
(*) « Dans le cas où GINGER CEBTP ne prélève pas les échantillons, le client assumera seul la responsabilité de la fourniture des échantillons et de la méthode de prélèvement utilisée. »

Mode de prélèvement :	Pelle Mécanique	Sondage :	VI.6.A
(*) Prélevé par :	CLIENT	Profondeur :	( )
Date prélèvement :	01/07/20		
Mode de conservation :	SAC		
Date de livraison :	23/07/20		
Description :	LIMON finement sableux brun, racines	Wnat (%) :	24.7

Informations sur l'essai

Mode de séchage :	Etuvage	Température :	105°C	Technicien :	MAZOUNI Mohammed
Type de moule :	Moule Proctor			Date essai :	05/08/20
Dame - Energie de compactage :	A - Normale			Essai sur matériau :	Non traité
Fraction testée :	0/D mm			Liant(s) et dosage(s) :	
				Préparation du matériau :	Manuelle

Les courbes de saturation Sr 80% et Sr 100% sont tracées avec la masse volumique des particules solides de sol de 2.7 Mg/m3 (estimée)



Résultats sur les 5 moulages

Points expérimentaux	1	2	3	4	5		
Teneur en eau initiale (%)	24.7	22.5	19.7	17.5	26.7		
Teneur en eau traitée (%)							
ρd (Mg/m3)	1.52	1.54	1.55	1.47	1.47		

Teneur en eau optimale (%)	19.7
ρd optimale (Mg/m3)	1.55
Teneur en eau optimale corrigée (%)	
ρd corrigée (Mg/m3)	

Observations

NB: correction pour les matériaux comportant moins de 30% d'éléments de dimension supérieure à 20 m

Chef de service laboratoire
Thierry LIPPLER

10 Appendix 3: JET results

Jet Erosion Test

Name of the test: SII_E1_A
Date of the test: 29/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

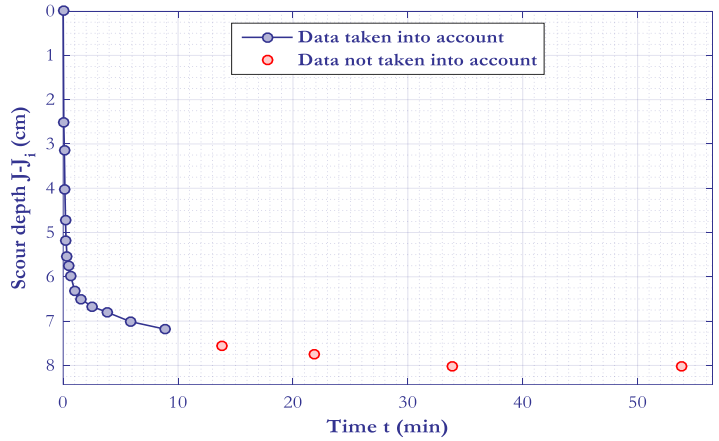
After the test

Sample type:	Intact	Water content:	15.8 %
Removed fraction:	-	Dry density:	1.59
Sample heigh:	18.0 cm	Wet density:	1.81

Observation before and after test

Presence of roots crossing the scour profil

Progress of the test



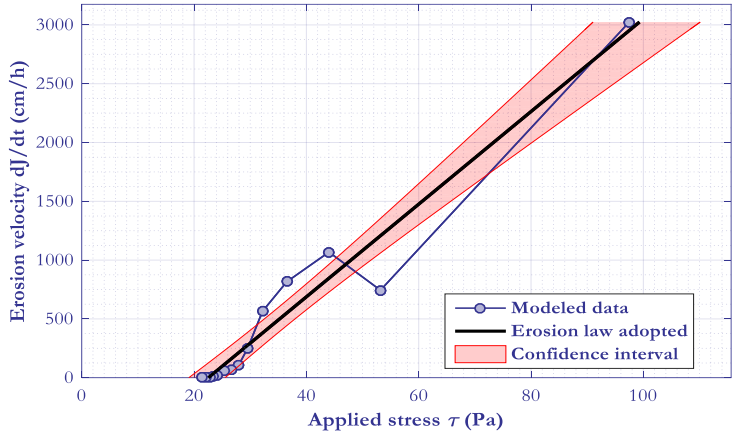
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.25 ± 0.04	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

Low erosion resume at the end of the test. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



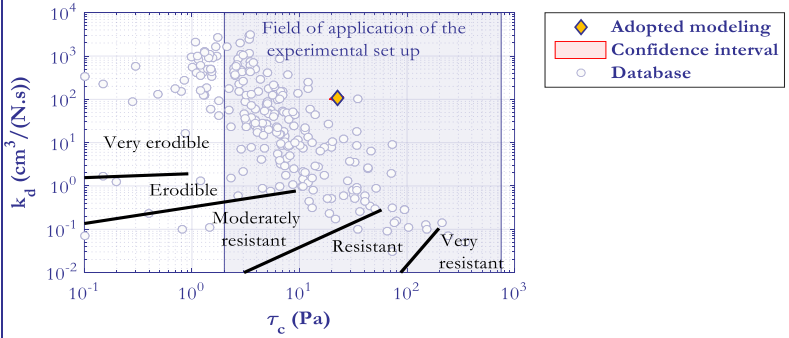
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	18	**23**	27	Pa
Hanson erosion coefficient:	kd	94	**110**	120	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		6.8		cm
Characteristic erosion time:	t95		0.7		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SII_E2_A
Date of the test: 30/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

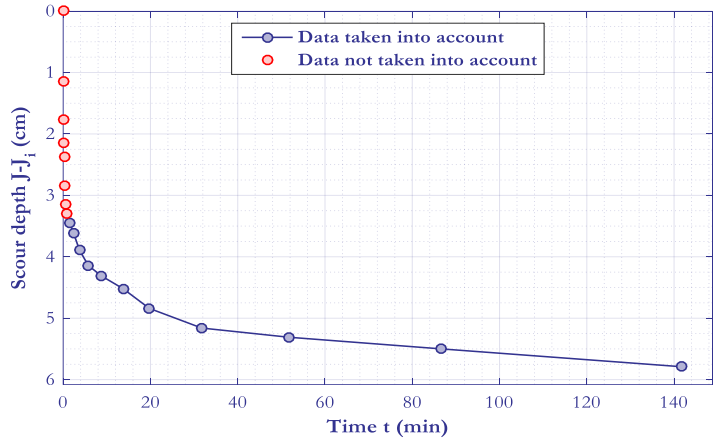
After the test

Sample type:	Intact	Water content:	16.3 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.54

Observation before and after test

Presence of roots crossing the scour profil

Progress of the test



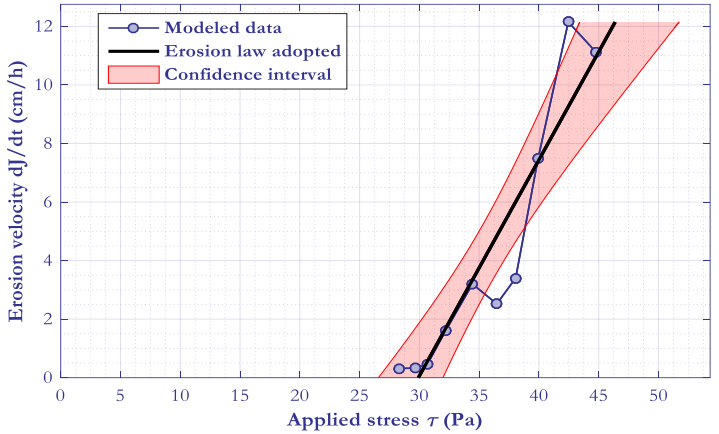
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.28 ± 0.02	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



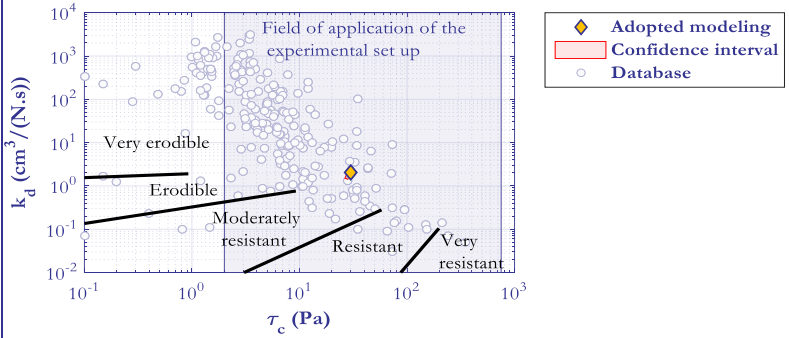
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	24	**30**	36	Pa
Hanson erosion coefficient:	kd	1.4	**2**	2.7	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		5.4		cm
Characteristic erosion time:	t95		22.9		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SII_E2_A
Date of the test: 30/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

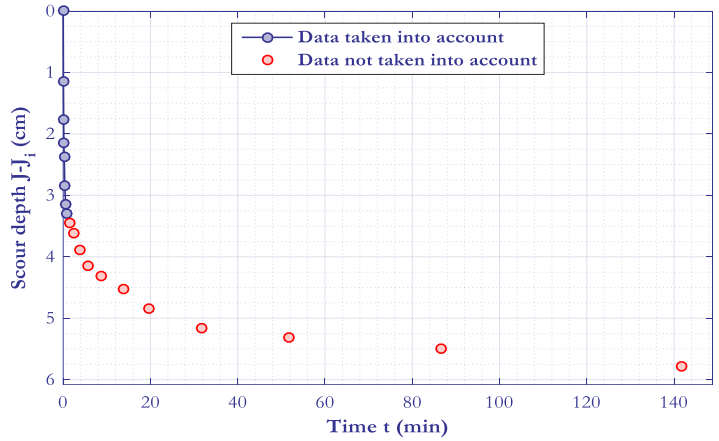
After the test

Sample type:	Intact	Water content:	16.3 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.54

Observation before and after test

Presence of roots crossing the scour profil

Progress of the test



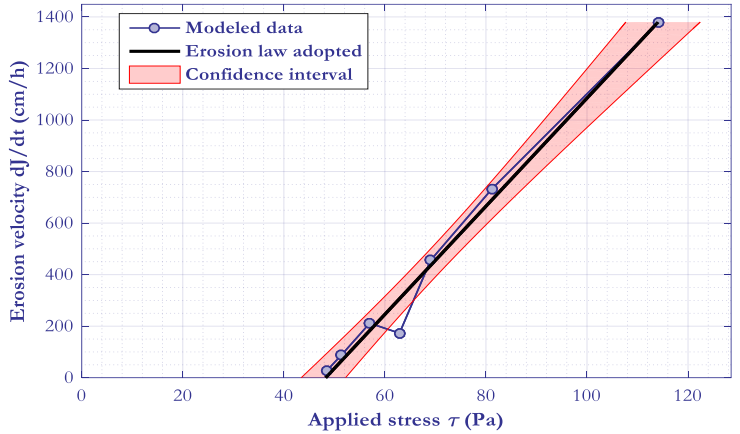
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.28 ± 0.02	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



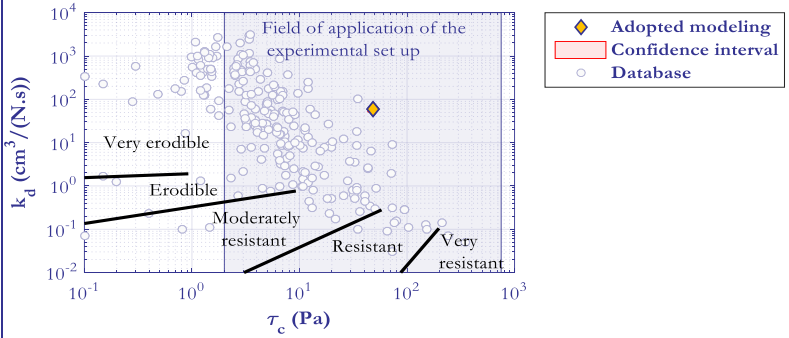
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	40	**48**	56	Pa
Hanson erosion coefficient:	kd	50	**58**	67	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.2		cm
Characteristic erosion time:	t95		0.4		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SII_E2_B
Date of the test: 30/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report:
geophy000367

Description of the sample

Before the test

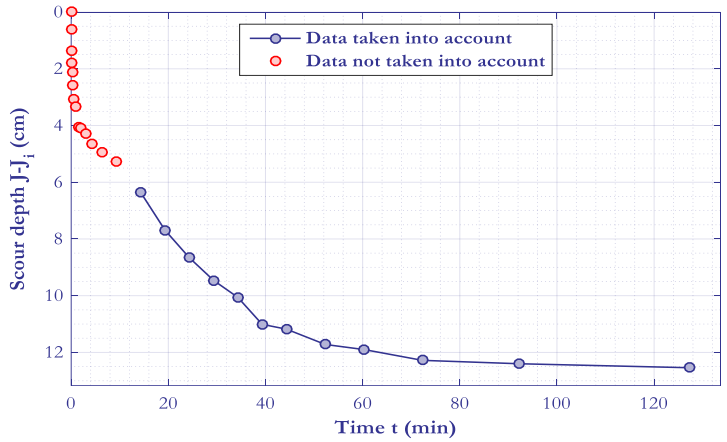
After the test

Sample type:	Intact	Water content:	9.2 %
Removed fraction:	-	Dry density:	1.43
Sample heigh:	18.0 cm	Wet density:	1.55

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



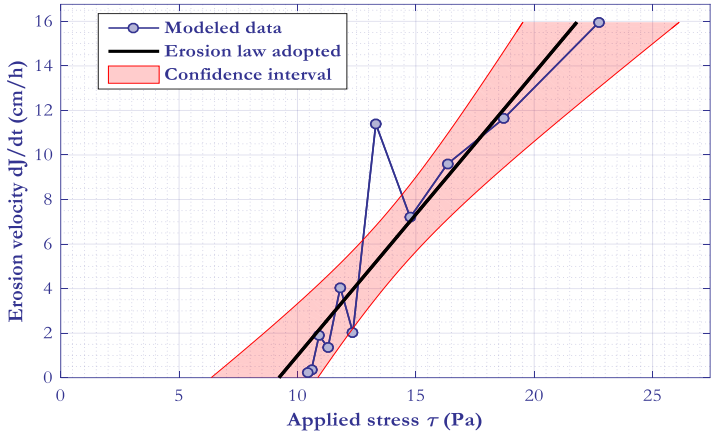
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	2.32 ± 0.02	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



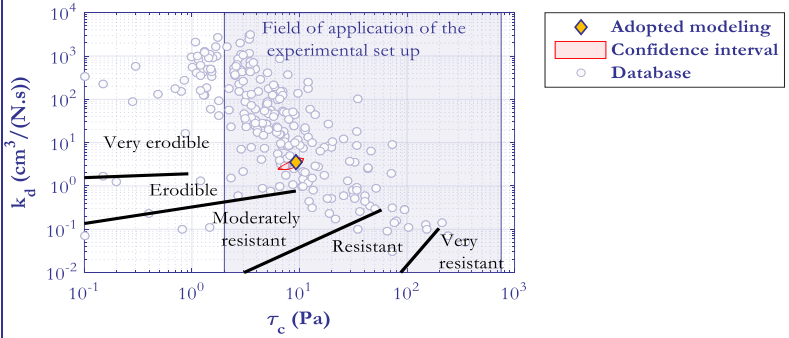
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	5	**9**	13	Pa
Hanson erosion coefficient:	kd	2.3	**3.5**	4.7	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		13.6		cm
Characteristic erosion time:	t95		81.5		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SII_E2_B
Date of the test: 30/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

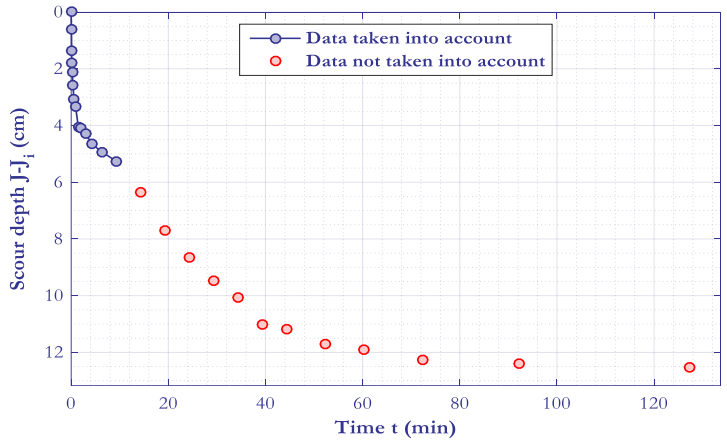
After the test

Sample type:	Intact	Water content:	9.2 %
Removed fraction:	-	Dry density:	1.43
Sample heigh:	18.0 cm	Wet density:	1.55

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



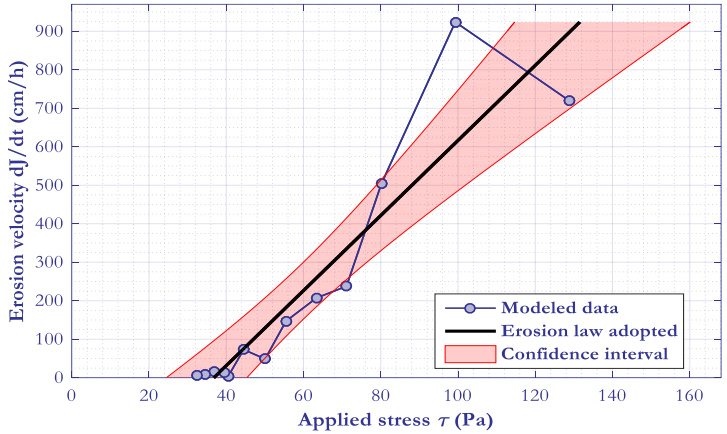
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	2.32 ± 0.02	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



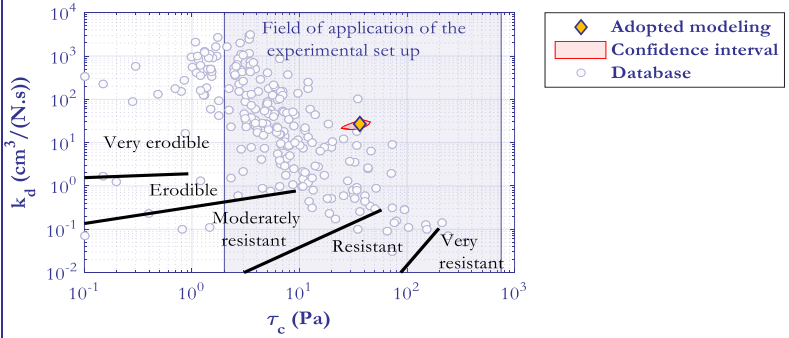
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	22	**37**	52	Pa
Hanson erosion coefficient:	kd	20	**27**	35	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		4.5		cm
Characteristic erosion time:	t95		1.3		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E1_A
Date of the test: 31/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

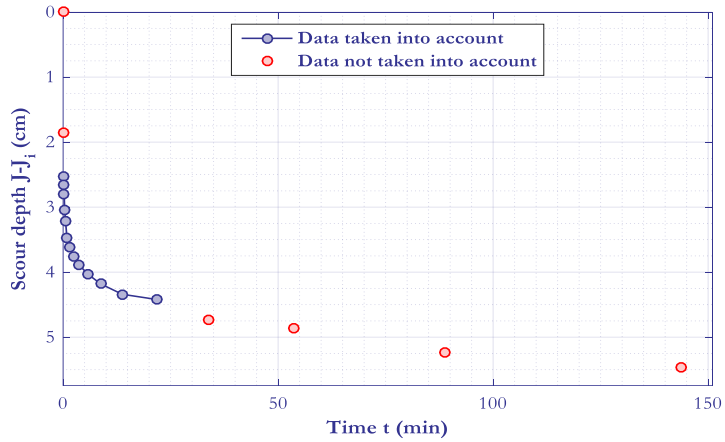
After the test

Sample type:	Intact	Water content:	20.5 %
Removed fraction:	-	Dry density:	1.37
Sample heigh:	18.0 cm	Wet density:	1.61

Observation before and after test

Presence of roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods

Progress of the test



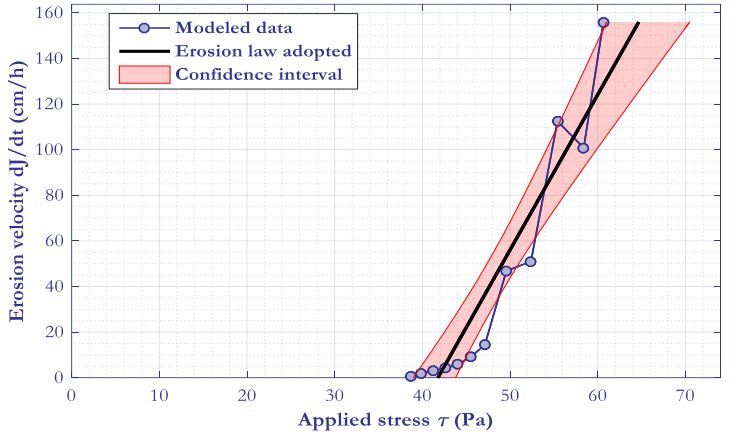
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.34 ± 0.03	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First points not consistent with the overall trend. Low erosion resume at the end of the test.
Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



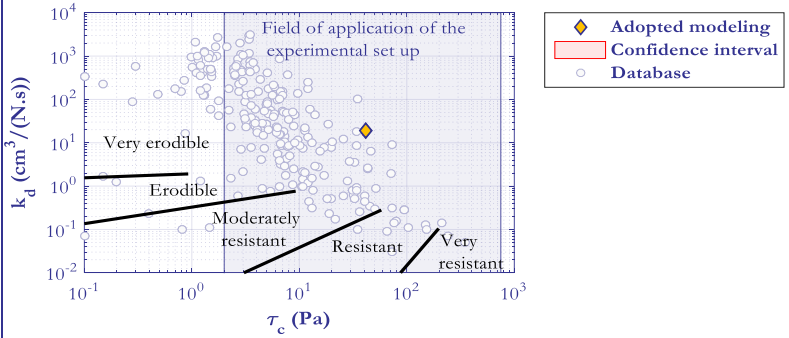
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	36	**42**	48	Pa
Hanson erosion coefficient:	kd	14	**19**	24	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		4.0		cm
Characteristic erosion time:	t95		1.5		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E2_A
Date of the test: 03/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

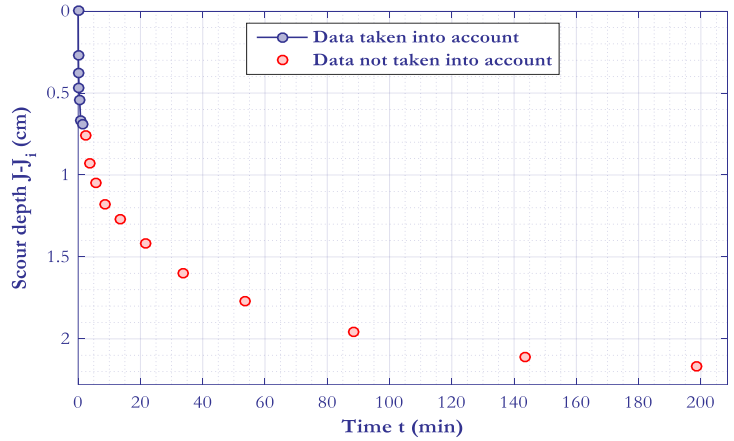
After the test

Sample type:	Intact	Water content:	26.7 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.63

Observation before and after test

Presence of roots crossing the scour profil

Progress of the test



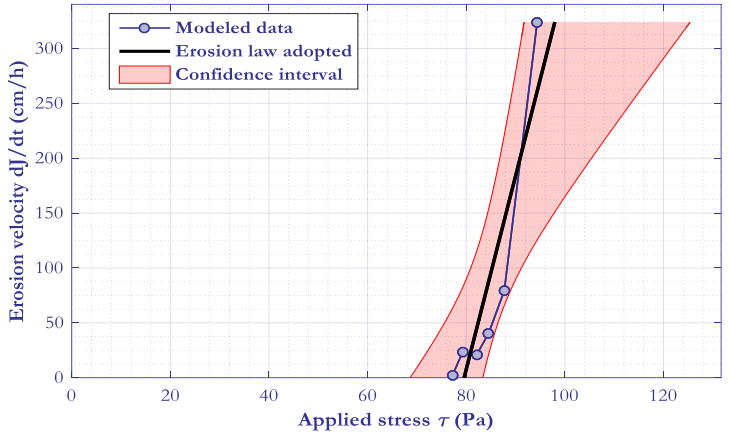
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	1.95 ± 0.02	mCe
Initial impact heigh:	Ji	5.1	cm

Observation during the test

Low final scour depth. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



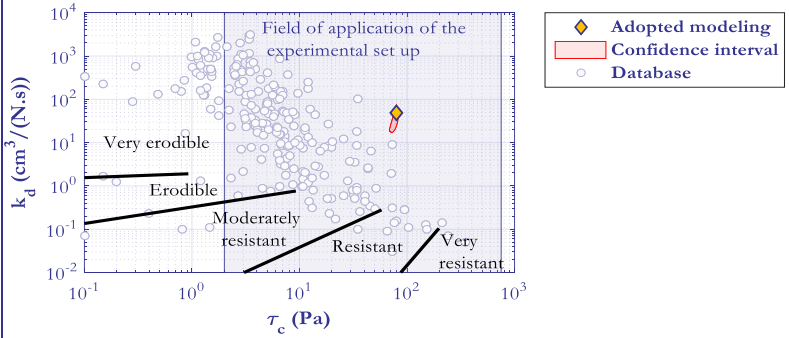
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s^2
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	61	**80**	98	Pa
Hanson erosion coefficient:	kd	17	**49**	81	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		0.6		cm
Characteristic erosion time:	t95		0.1		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E2_A
Date of the test: 03/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

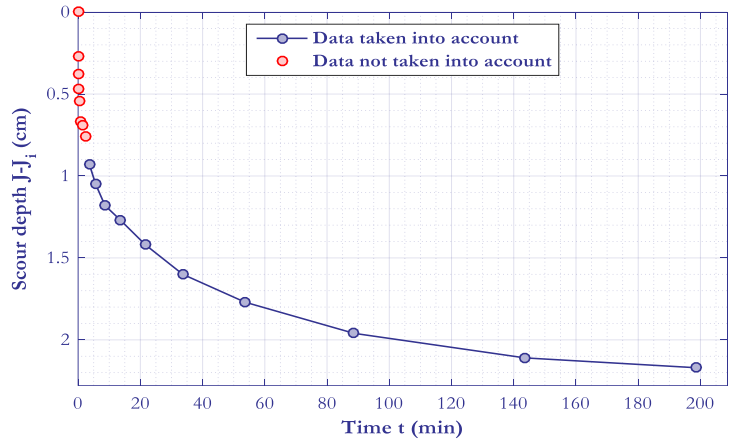
After the test

Sample type:	Intact	Water content:	26.7 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.63

Observation before and after test

Presence of roots crossing the scour profil

Progress of the test



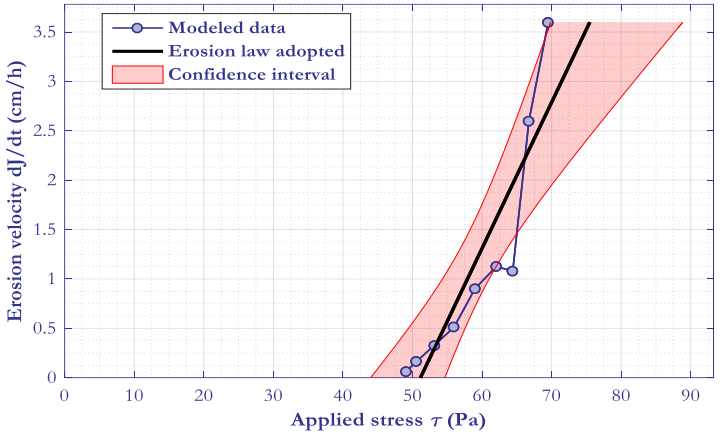
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	1.95 ± 0.02	mCe
Initial impact heigh:	Ji	5.1	cm

Observation during the test

Low final scour depth. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



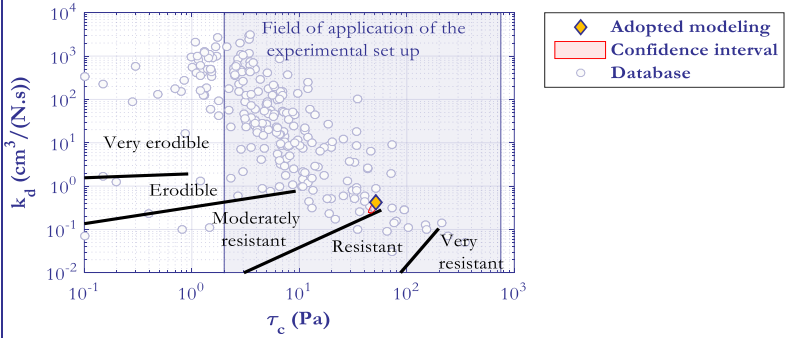
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	38	**51**	64	Pa
Hanson erosion coefficient:	kd	0.23	**0.41**	0.59	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		2.0		cm
Characteristic erosion time:	t95		39.1		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E2_B
Date of the test: 31/07/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

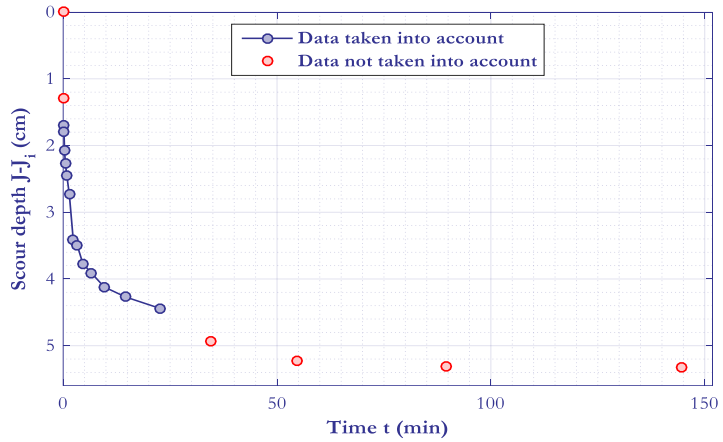
After the test

Sample type:	Intact	Water content:	17.2 %
Removed fraction:	-	Dry density:	1.29
Sample heigh:	18.0 cm	Wet density:	1.48

Observation before and after test

Presence of roots crossing the scour profil. Soil made of clods (clearly visible after test)

Progress of the test



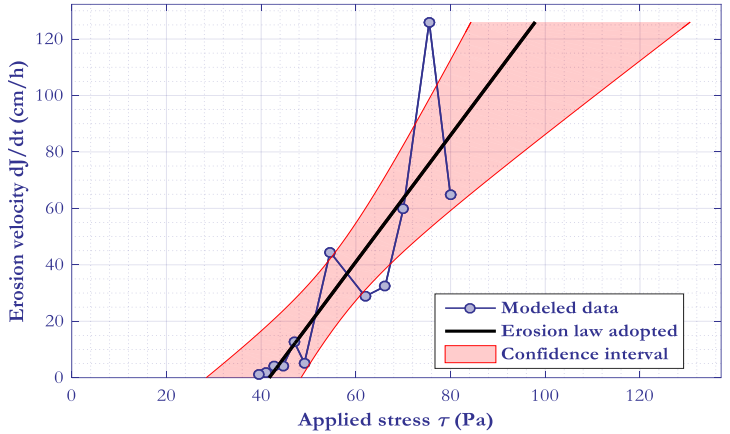
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.34 ± 0.02	mCe
Initial impact heigh:	Ji	4.4	cm

Observation during the test

First points not consistent with the overall trend. Low erosion resume at the end of the test.
Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



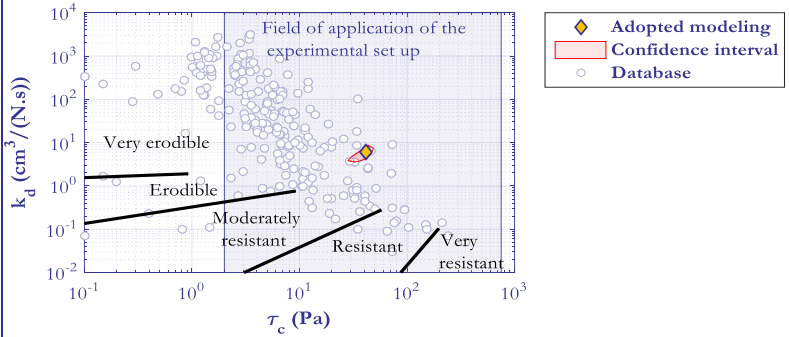
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	24	**42**	59	Pa
Hanson erosion coefficient:	kd	3.5	**6.2**	8.9	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		4.1		cm
Characteristic erosion time:	t95		4.5		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E4_A
Date of the test: 03/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

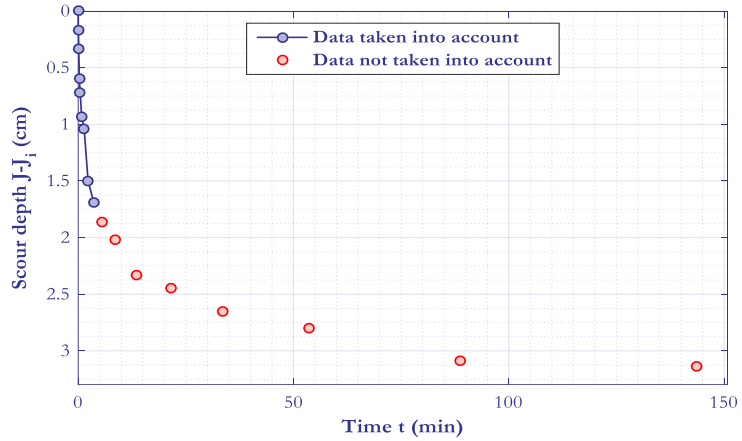
After the test

Sample type:	Intact	Water content:	26.7 %
Removed fraction:	-	Dry density:	1.40
Sample heigh:	18.0 cm	Wet density:	1.69

Observation before and after test

Presence of many roots crossing the scour profil. Soil made of clods. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



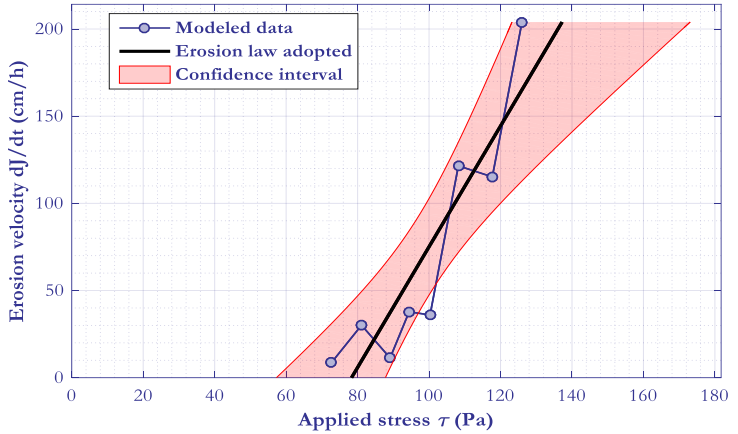
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.19 ± 0.02	mCe
Initial impact heigh:	Ji	4.7	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



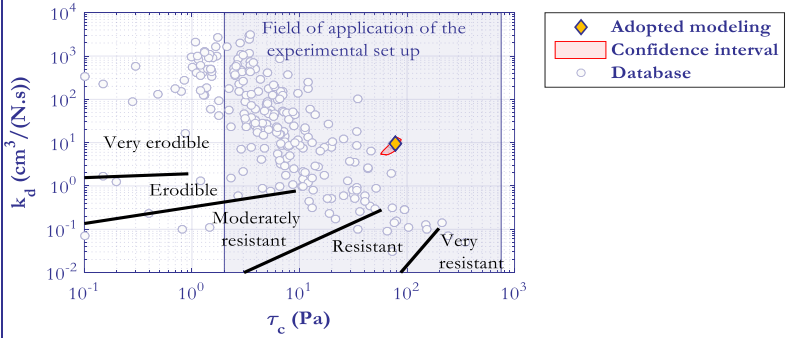
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	49	**78**	110	Pa
Hanson erosion coefficient:	kd	5.1	**9.6**	14	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		1.4		cm
Characteristic erosion time:	t95		0.8		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E4_A
Date of the test: 03/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

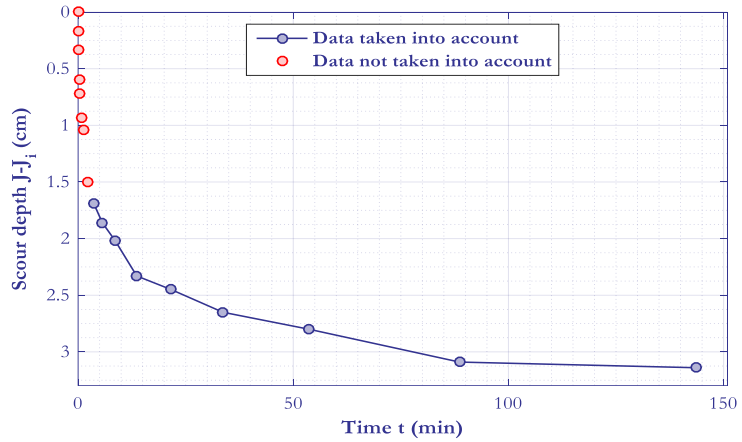
After the test

Sample type:	Intact	Water content:	26.7 %
Removed fraction:	-	Dry density:	1.40
Sample heigh:	18.0 cm	Wet density:	1.69

Observation before and after test

Presence of many roots crossing the scour profil. Soil made of clods. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



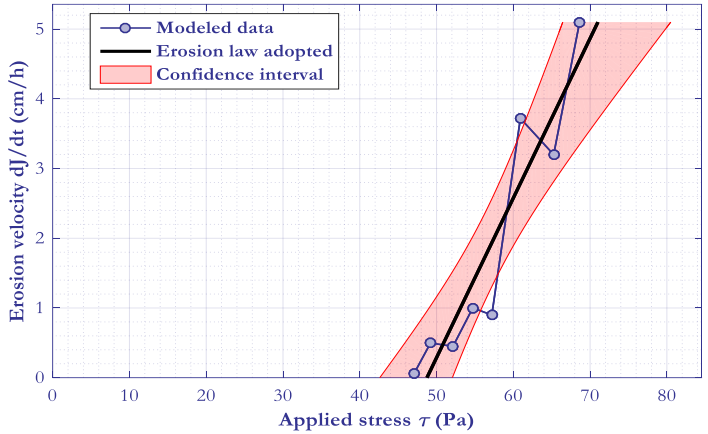
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.19 ± 0.02	mCe
Initial impact heigh:	Ji	4.7	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



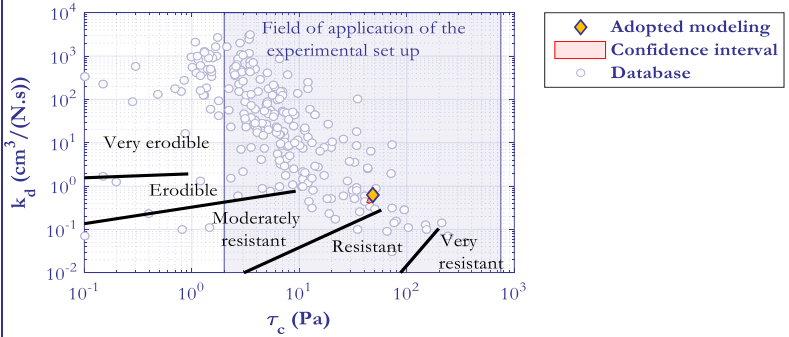
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	37	**49**	60	Pa
Hanson erosion coefficient:	kd	0.39	**0.64**	0.88	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.0		cm
Characteristic erosion time:	t95		32.2		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E5_A
Date of the test: 04/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

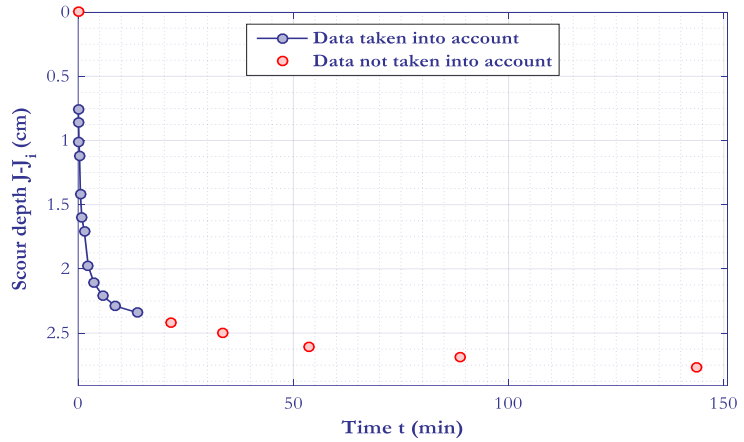
After the test

Sample type:	Intact	Water content:	27.0 %
Removed fraction:	-	Dry density:	1.28
Sample heigh:	18.0 cm	Wet density:	1.55

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



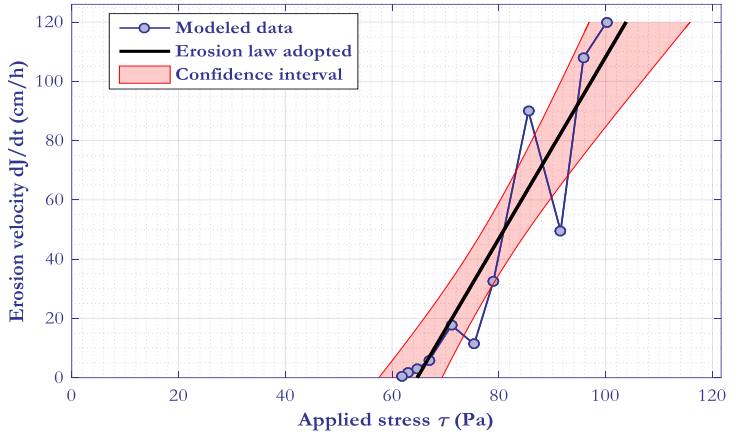
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.34 ± 0.03	mCe
Initial impact heigh:	Ji	4.7	cm

Observation during the test

Low final scour depth.
First points not consistent with the overall trend. Low erosion resume at the end of the test. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



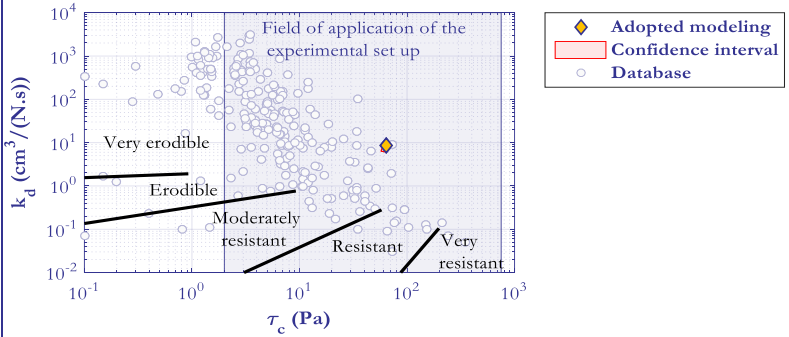
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	51	**65**	78	Pa
Hanson erosion coefficient:	kd	6	**8.5**	11	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		2.2		cm
Characteristic erosion time:	t95		1.5		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E6_A
Date of the test: 05/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

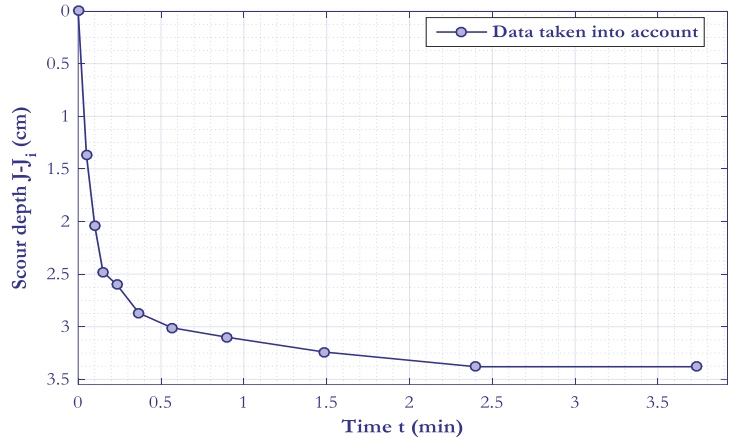
After the test

Sample type:	Intact	Water content:	24.7 %
Removed fraction:	-	Dry density:	1.33
Sample heigh:	18.0 cm	Wet density:	1.60

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



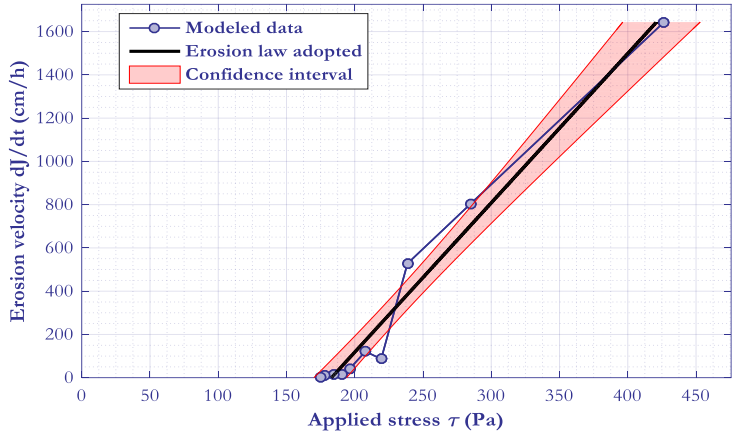
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.30 ± 0.10	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

No specific observation

Test modeling

$dJ/dt = kd(\tau - \tau c)$



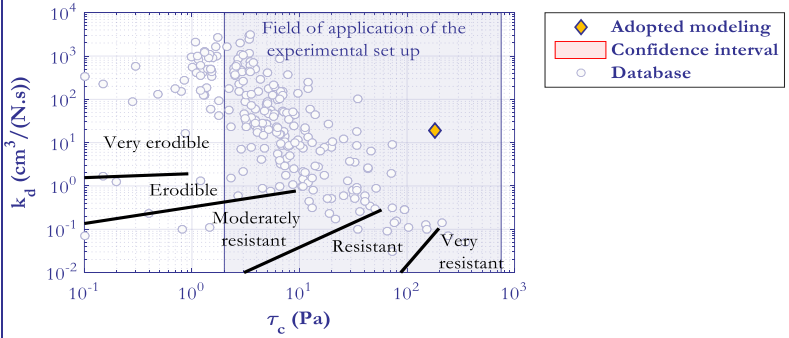
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	160	**180**	200	Pa
Hanson erosion coefficient:	kd	17	**19**	22	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.2		cm
Characteristic erosion time:	t95		0.3		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SIV_E7_A
Date of the test: 05/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

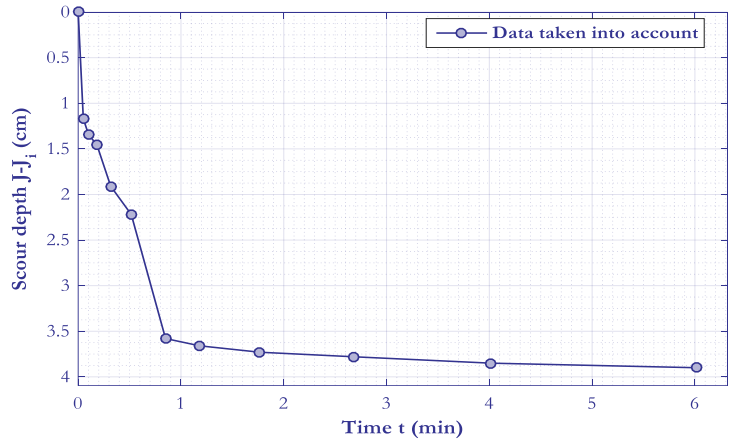
After the test

Sample type:	Intact	Water content:	22.2 %
Removed fraction:	-	Dry density:	1.44
Sample heigh:	18.0 cm	Wet density:	1.70

Observation before and after test

Soil made of clods. Presence of roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



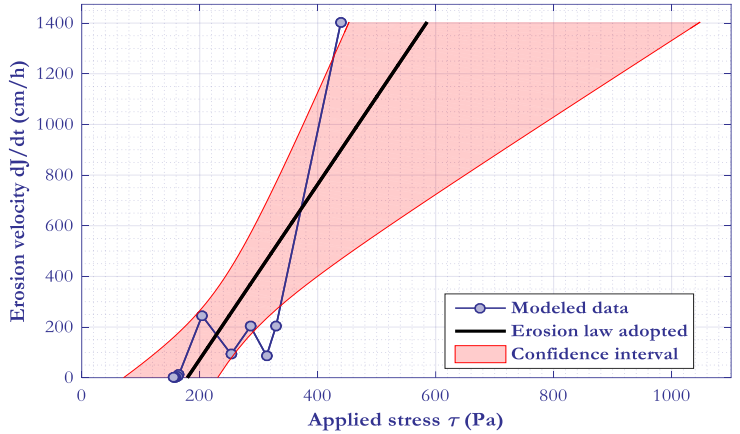
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.08	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

Probable detachment of a centimeter clod during the first minute of testing

Test modeling

$dJ/dt = kd(\tau - \tau c)$



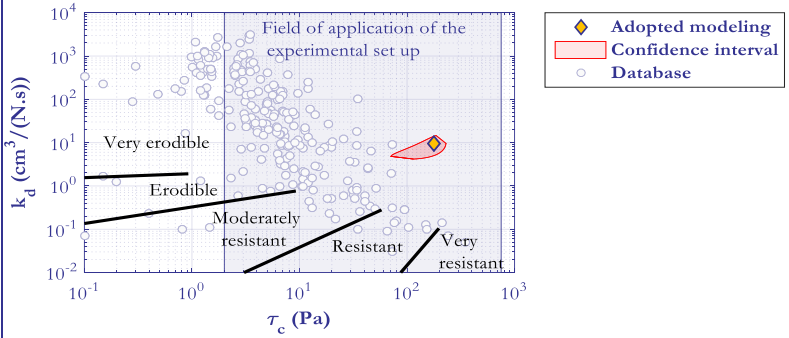
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	76	**180**	280	Pa
Hanson erosion coefficient:	kd	4.1	**9.6**	15	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.3		cm
Characteristic erosion time:	t95		0.6		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

Higher than usual uncertainty on the result due to the probable detachment of a centimeter clod of soil at the start of the test

Jet Erosion Test

Name of the test: SVI_E1_A
Date of the test: 06/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

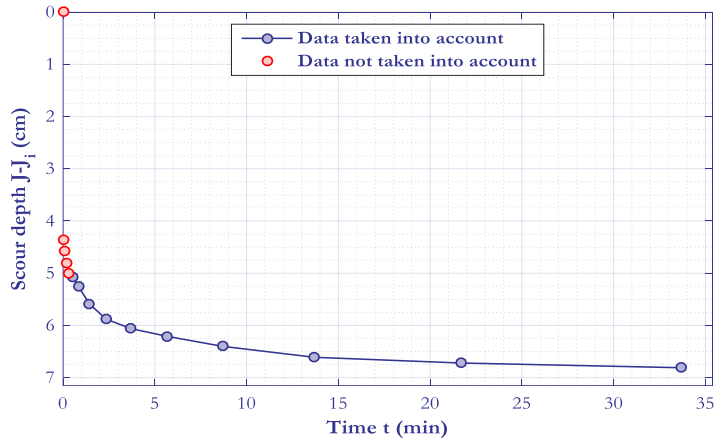
After the test

Sample type:	Intact	Water content:	23.8 %
Removed fraction:	-	Dry density:	1.37
Sample heigh:	18.0 cm	Wet density:	1.63

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



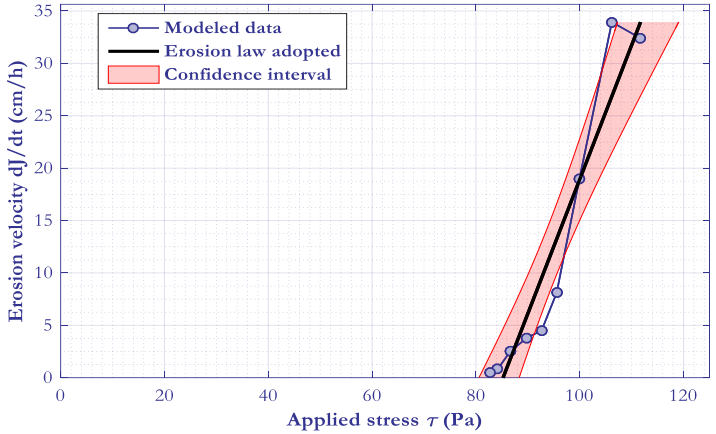
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.30 ± 0.10	mCe
Initial impact heigh:	Ji	4.7	cm

Observation during the test

First point not consistent with the overall trend. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



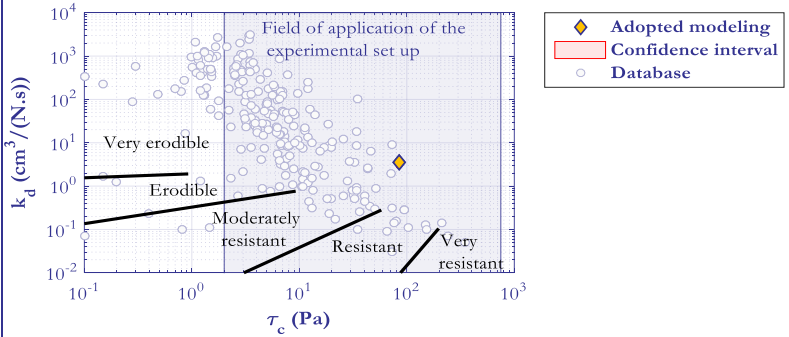
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	74	**85**	97	Pa
Hanson erosion coefficient:	kd	2.6	**3.6**	4.5	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		6.6		cm
Characteristic erosion time:	t95		5.3		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E1_A
Date of the test: 06/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

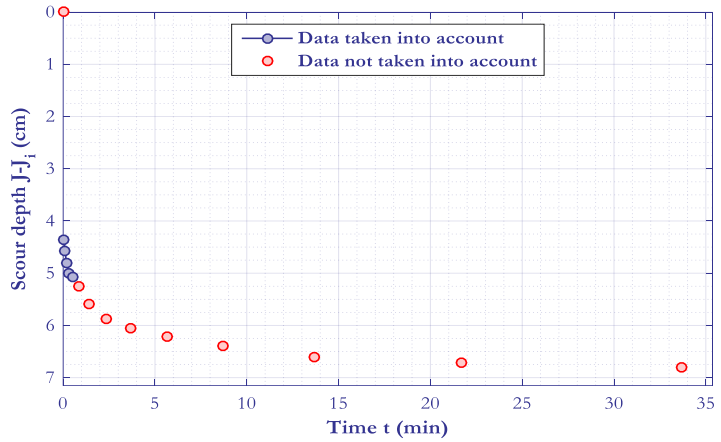
After the test

Sample type:	Intact	Water content:	23.8 %
Removed fraction:	-	Dry density:	1.37
Sample heigh:	18.0 cm	Wet density:	1.63

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



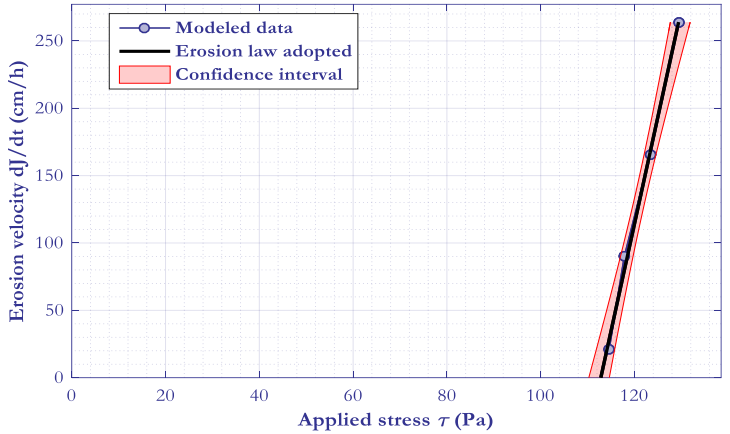
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.30 ± 0.10	mCe
Initial impact heigh:	Ji	4.7	cm

Observation during the test

First point not consistent with the overall trend. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



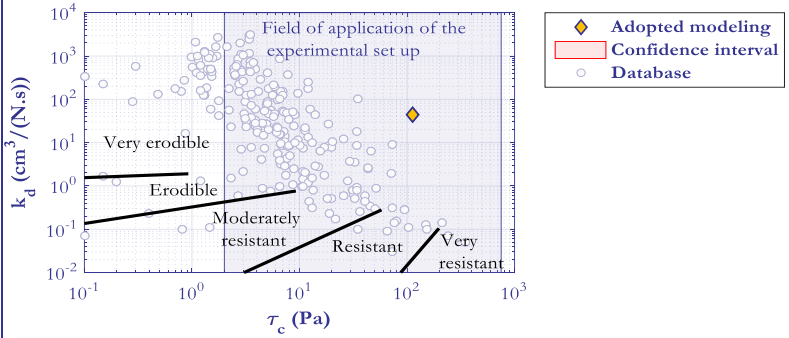
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	100	**110**	120	Pa
Hanson erosion coefficient:	kd	35	**44**	53	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		5.1		cm
Characteristic erosion time:	t95		0.3		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E2_A
Date of the test: 06/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report:
geophy000367

Description of the sample

Before the test

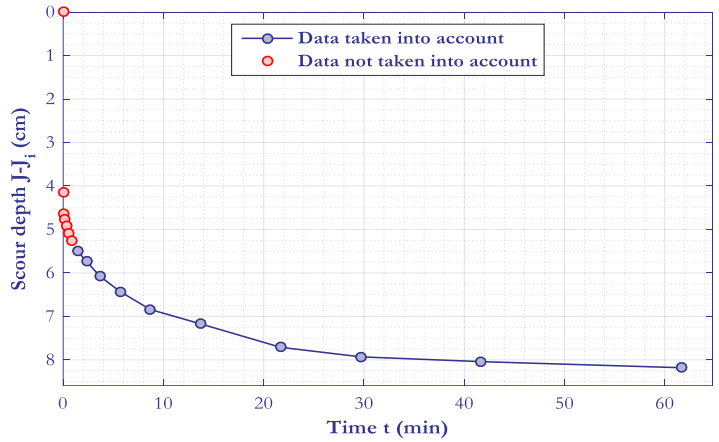
After the test

Sample type:	Intact	Water content:	25.3 %
Removed fraction:	-	Dry density:	1.30
Sample heigh:	18.0 cm	Wet density:	1.56

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



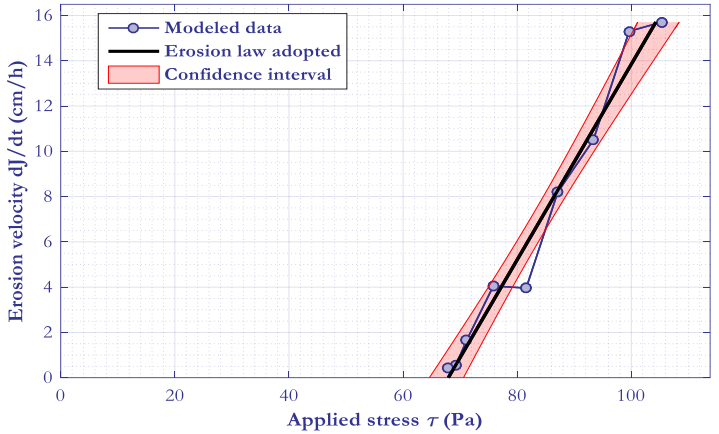
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.11	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First points not consistent with the overall trend. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



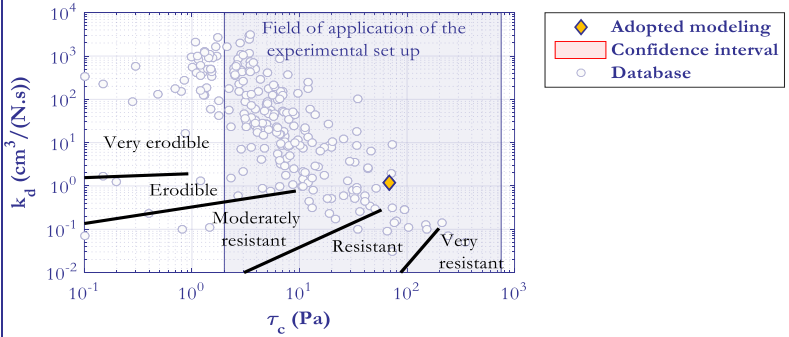
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	61	**68**	75	Pa
Hanson erosion coefficient:	kd	1	**1.2**	1.4	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		8.1		cm
Characteristic erosion time:	t95		22.3		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E2_A
Date of the test: 06/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

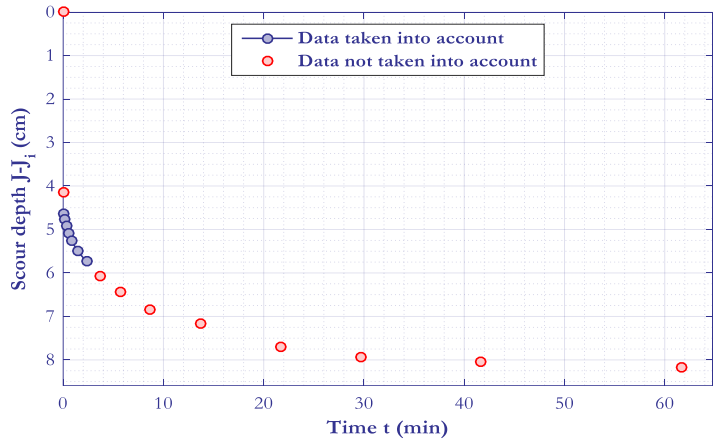
After the test

Sample type:	Intact	Water content:	25.3 %
Removed fraction:	-	Dry density:	1.30
Sample heigh:	18.0 cm	Wet density:	1.56

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



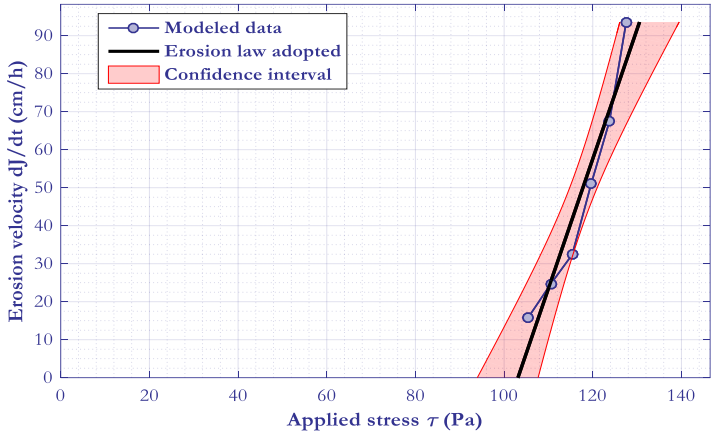
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.11	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First points not consistent with the overall trend. Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



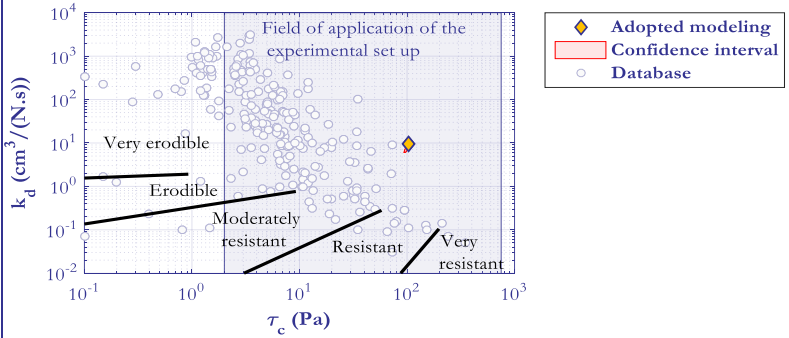
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	82	**100**	120	Pa
Hanson erosion coefficient:	kd	5.9	**9.5**	13	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		5.7		cm
Characteristic erosion time:	t95		1.5		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E3_A
Date of the test: 06/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

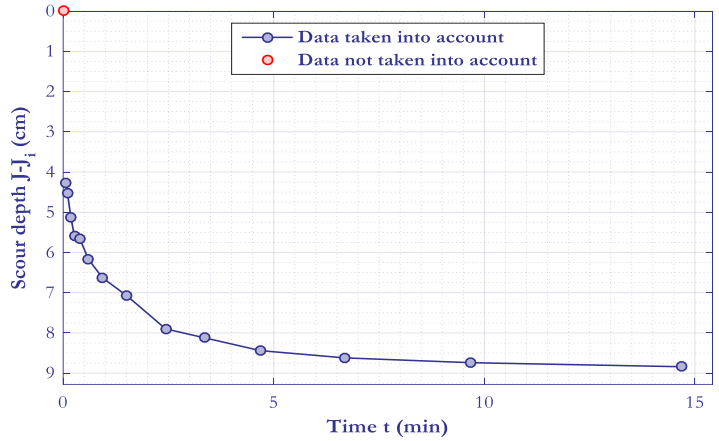
After the test

Sample type:	Intact	Water content:	18.8 %
Removed fraction:	-	Dry density:	1.31
Sample heigh:	18.0 cm	Wet density:	1.51

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods. Soil clods clearly visible after test.

Progress of the test



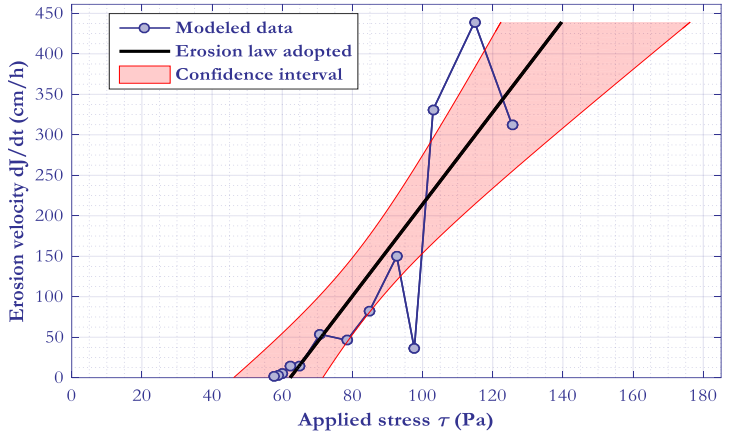
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.12	mCe
Initial impact heigh:	Ji	4.9	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



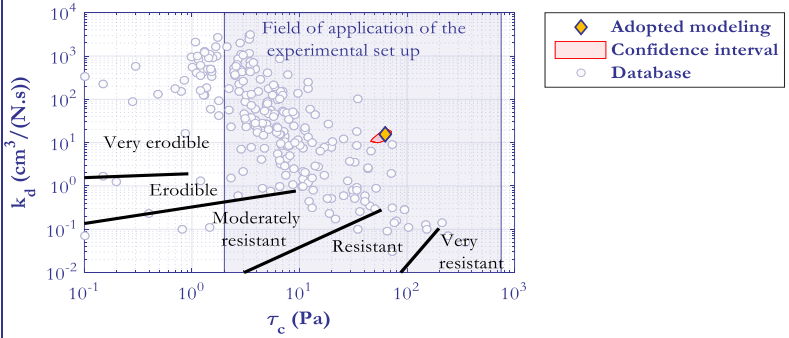
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	40	**62**	84	Pa
Hanson erosion coefficient:	kd	9.8	**16**	22	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		8.3		cm
Characteristic erosion time:	t95		1.9		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E4_A
Date of the test: 07/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

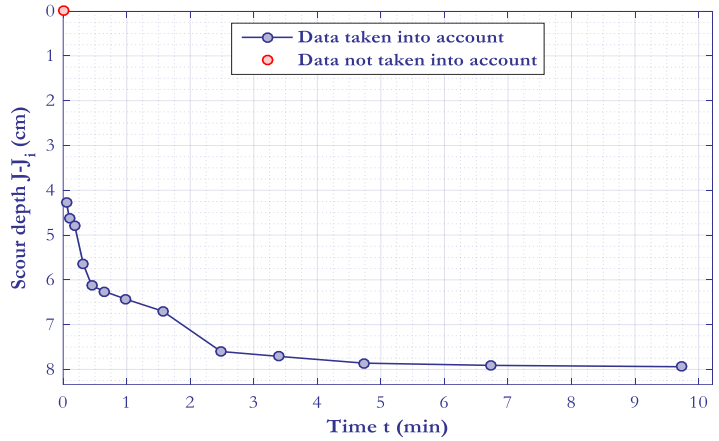
After the test

Sample type:	Intact	Water content:	22.6 %
Removed fraction:	-	Dry density:	1.30
Sample heigh:	18.0 cm	Wet density:	1.54

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



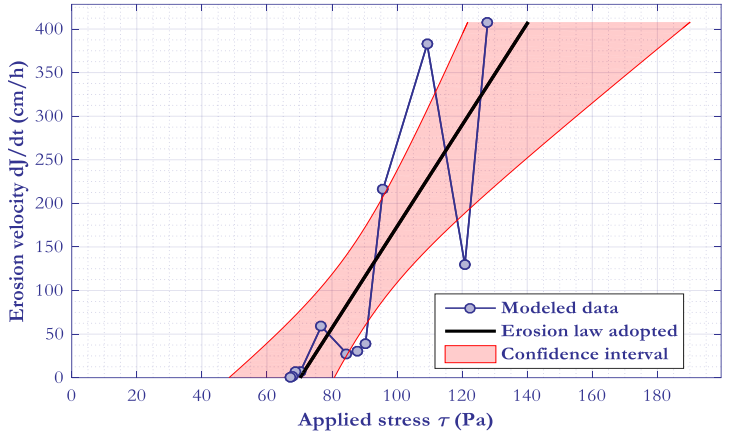
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.11	mCe
Initial impact heigh:	Ji	4.8	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



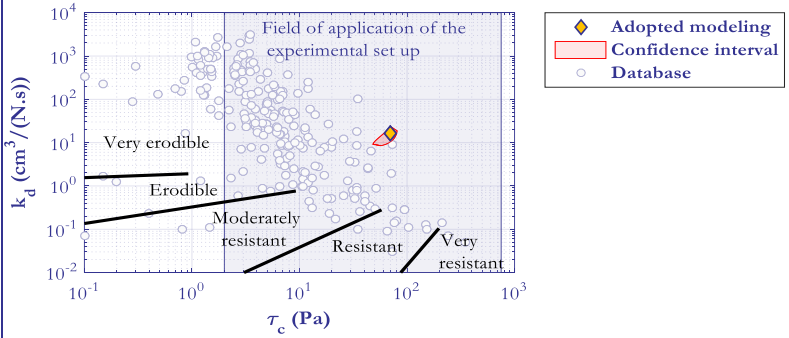
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	42	**70**	98	Pa
Hanson erosion coefficient:	kd	8.4	**16**	24	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		7.7		cm
Characteristic erosion time:	t95		1.6		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E5_A
Date of the test: 07/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

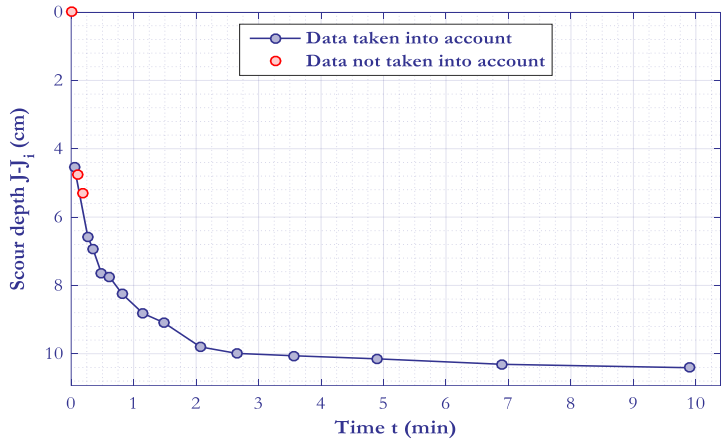
After the test

Sample type:	Intact	Water content:	23.7 %
Removed fraction:	-	Dry density:	1.31
Sample heigh:	18.0 cm	Wet density:	1.56

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



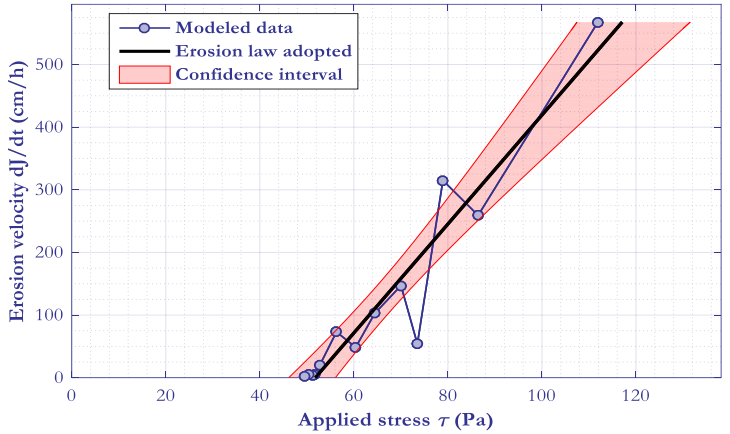
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.11	mCe
Initial impact heigh:	Ji	4.4	cm

Observation during the test

Some of first points not consistent with the overall trend. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



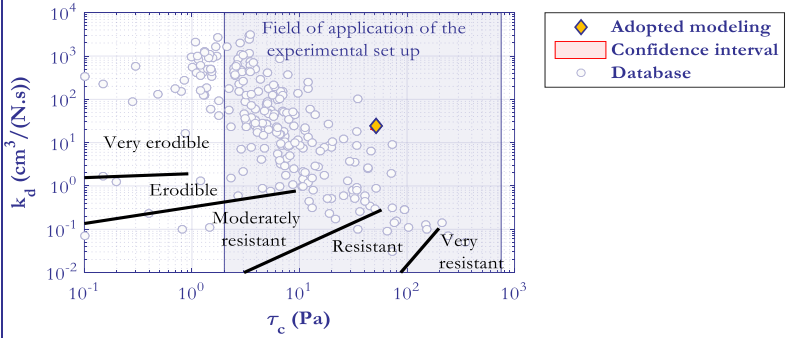
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	42	**52**	61	Pa
Hanson erosion coefficient:	kd	19	**24**	29	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		10.0		cm
Characteristic erosion time:	t95		1.7		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E6_A
Date of the test: 07/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

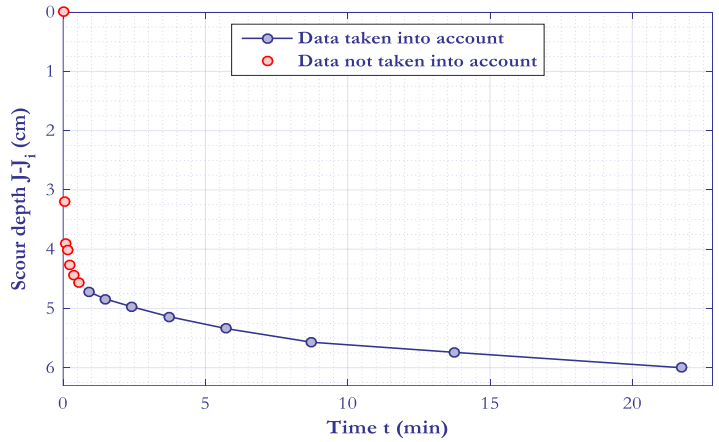
After the test

Sample type:	Intact	Water content:	23.5 %
Removed fraction:	-	Dry density:	1.39
Sample heigh:	18.0 cm	Wet density:	1.65

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



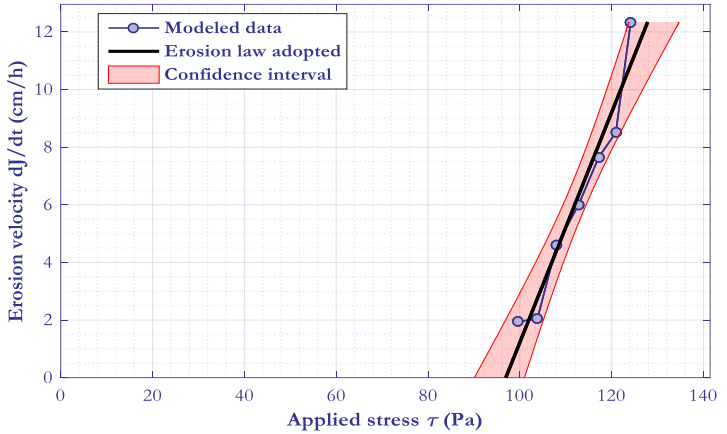
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.12	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling.

Test modeling

$dJ/dt = kd(\tau - \tau c)$



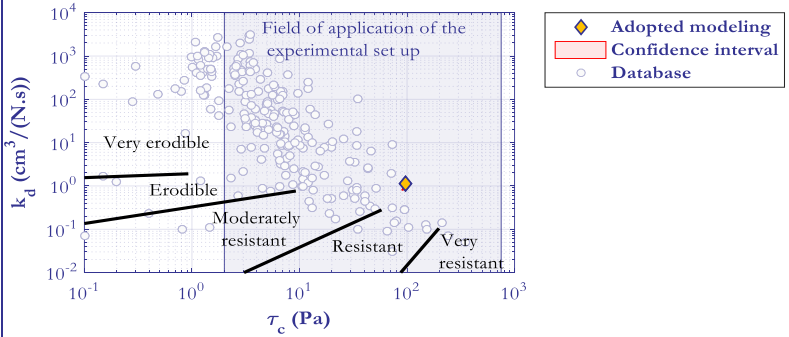
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	80	**97**	110	Pa
Hanson erosion coefficient:	kd	0.79	**1.1**	1.4	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		6.0		cm
Characteristic erosion time:	t95		13.9		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E6_A
Date of the test: 07/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

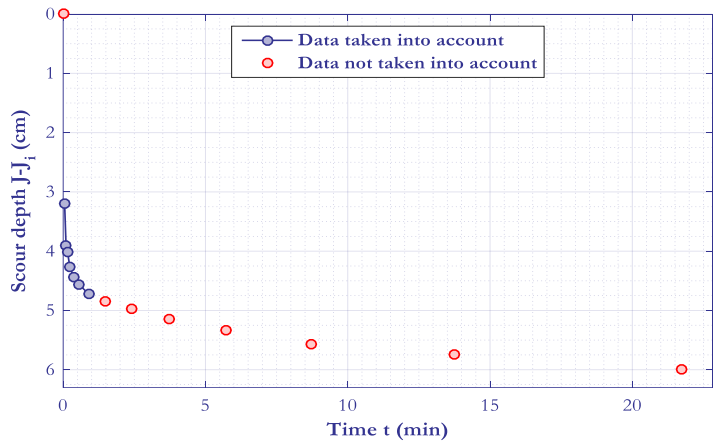
After the test

Sample type:	Intact	Water content:	23.5 %
Removed fraction:	-	Dry density:	1.39
Sample heigh:	18.0 cm	Wet density:	1.65

Observation before and after test

Presence of many roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



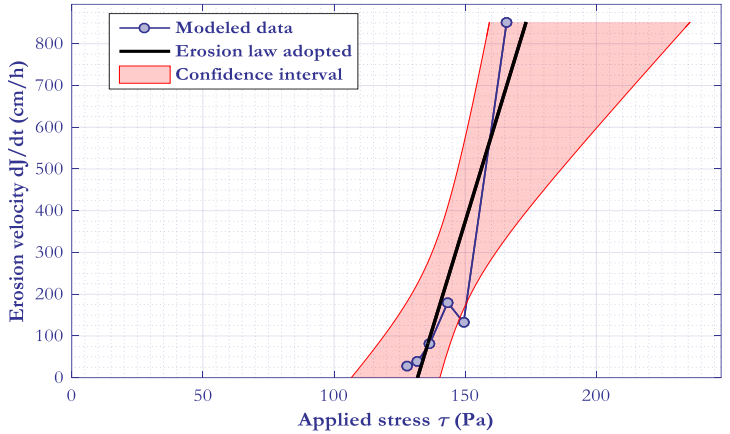
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.12	mCe
Initial impact heigh:	Ji	4.6	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling.
Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



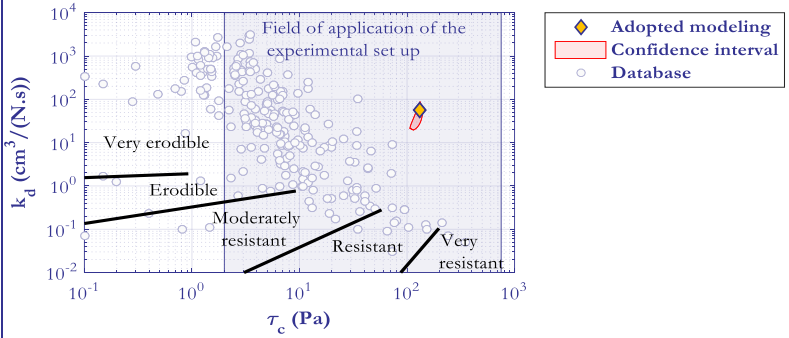
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	95	**130**	170	Pa
Hanson erosion coefficient:	kd	19	**57**	95	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		4.5		cm
Characteristic erosion time:	t95		0.2		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E6_B
Date of the test: 10/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report:
geophy000367

Description of the sample

Before the test

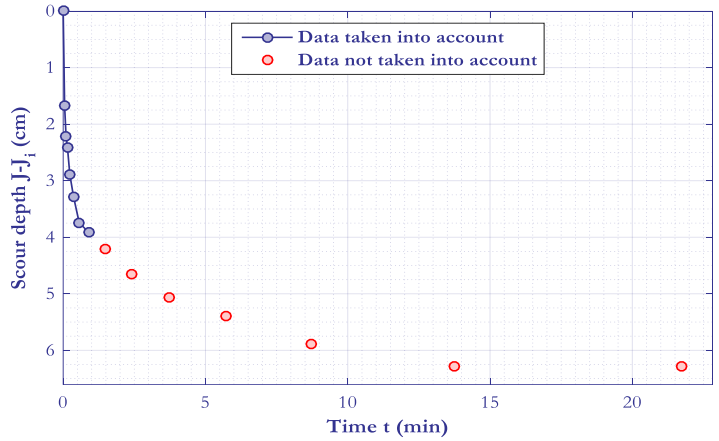
After the test

Sample type:	Intact	Water content:	23.0 %
Removed fraction:	-	Dry density:	1.30
Sample heigh:	18.0 cm	Wet density:	1.54

Observation before and after test

Presence of roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



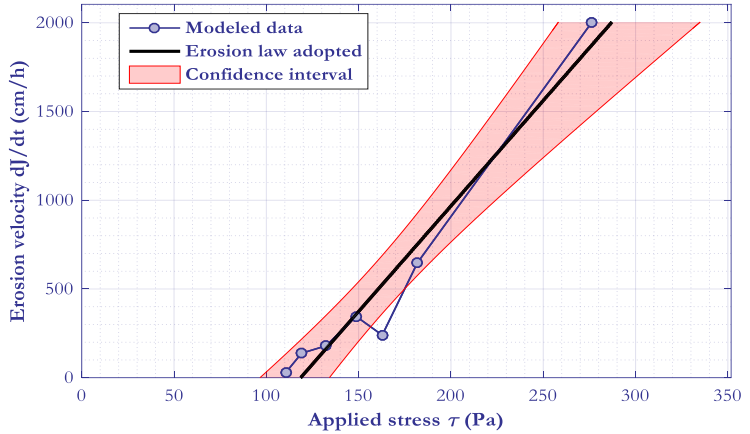
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	6.31 ± 0.09	mCe
Initial impact heigh:	Ji	4.8	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



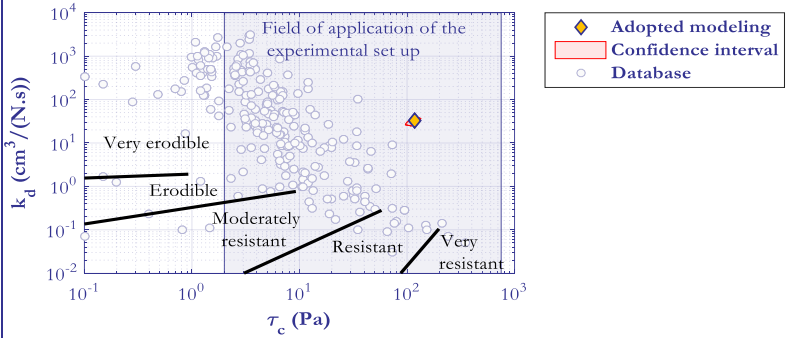
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	86	**120**	150	Pa
Hanson erosion coefficient:	kd	24	**33**	42	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.5		cm
Characteristic erosion time:	t95		0.3		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SVI_E6_B
Date of the test: 10/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

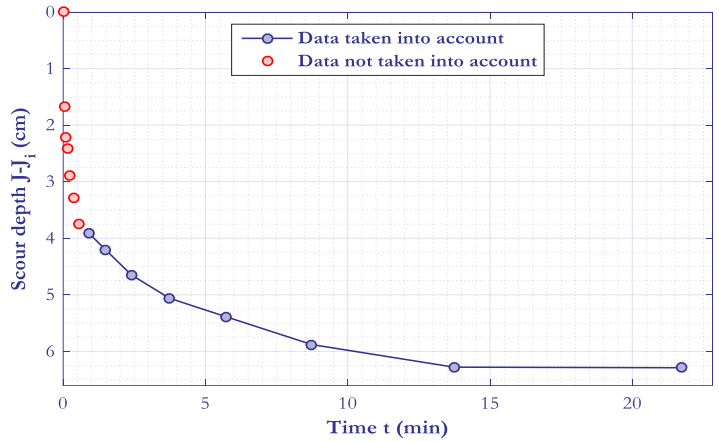
After the test

Sample type:	Intact	Water content:	23.0 %
Removed fraction:	-	Dry density:	1.30
Sample heigh:	18.0 cm	Wet density:	1.54

Observation before and after test

Presence of roots crossing the scour profil. Asymmetric final scour profile due to detachment of soil clods.

Progress of the test



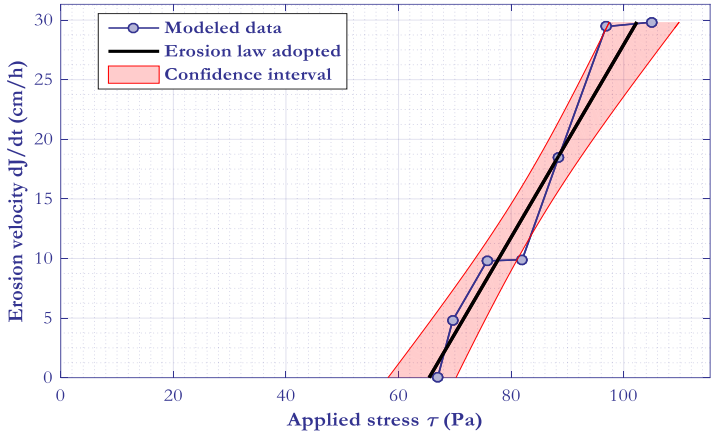
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	6.31 ± 0.09	mCe
Initial impact heigh:	Ji	4.8	cm

Observation during the test

Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



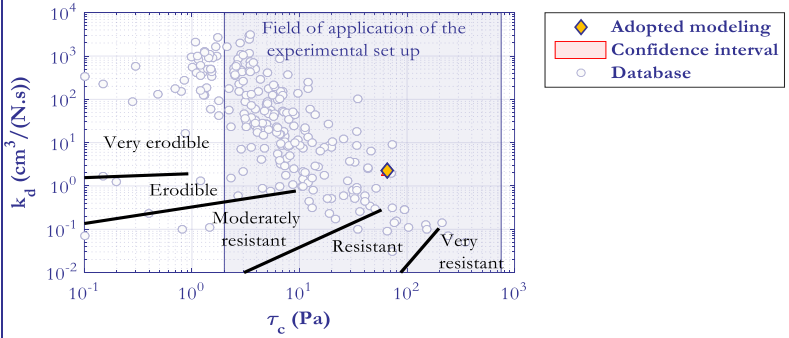
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	52	**65**	79	Pa
Hanson erosion coefficient:	kd	1.7	**2.2**	2.8	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		6.4		cm
Characteristic erosion time:	t95		10.8		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SX_E1_A
Date of the test: 10/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

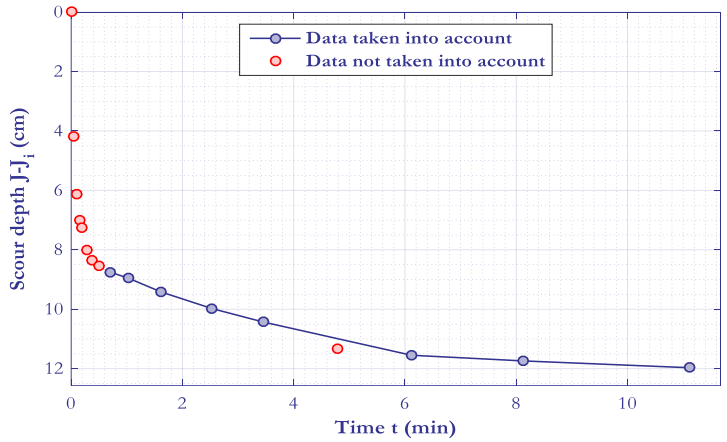
After the test

Sample type:	Intact	Water content:	17.3 %
Removed fraction:	-	Dry density:	1.36
Sample heigh:	18.0 cm	Wet density:	1.56

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



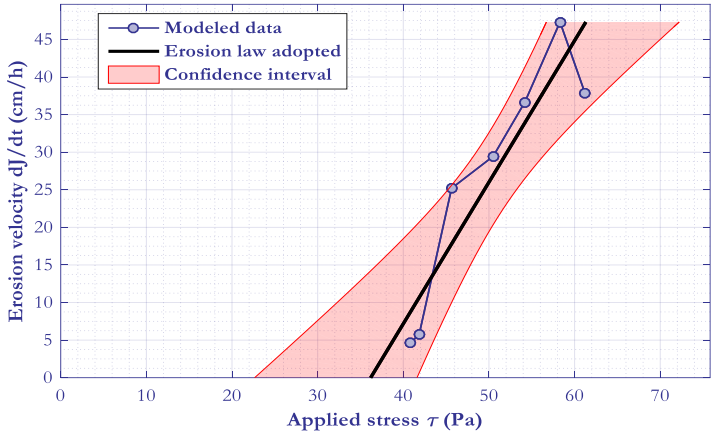
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	8.30 ± 0.12	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling
Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



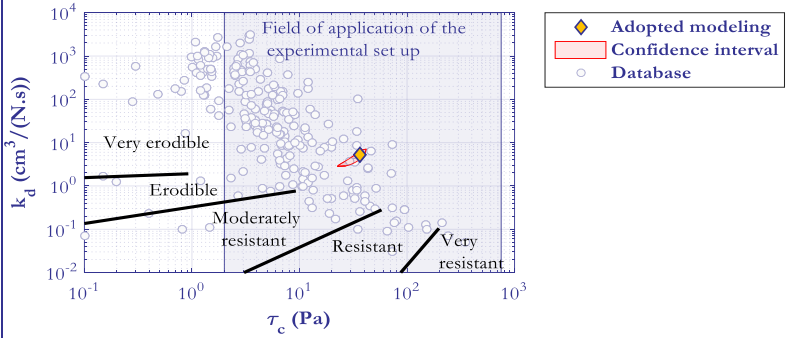
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	19	**36**	53	Pa
Hanson erosion coefficient:	kd	2.8	**5.2**	7.7	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		12.9		cm
Characteristic erosion time:	t95		13.3		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SX_E1_A
Date of the test: 10/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

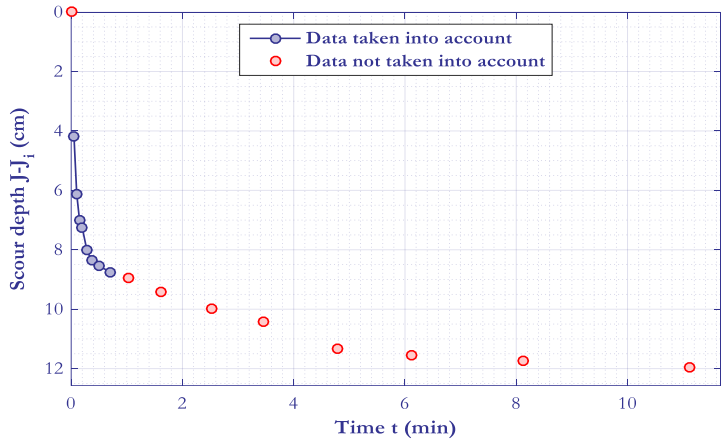
After the test

Sample type:	Intact	Water content:	17.3 %
Removed fraction:	-	Dry density:	1.36
Sample heigh:	18.0 cm	Wet density:	1.56

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



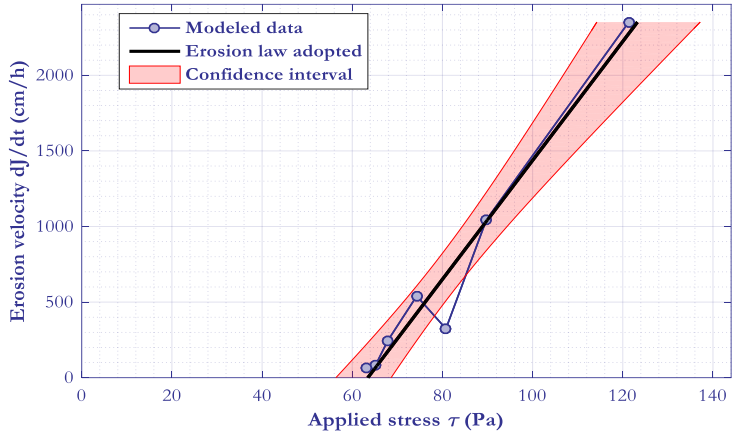
Test parameters	Symbols	Values	Units
Jet diameter:	d_0	6.35	mm
Hydraulic load applied:	h	8.30 ± 0.12	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling
Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



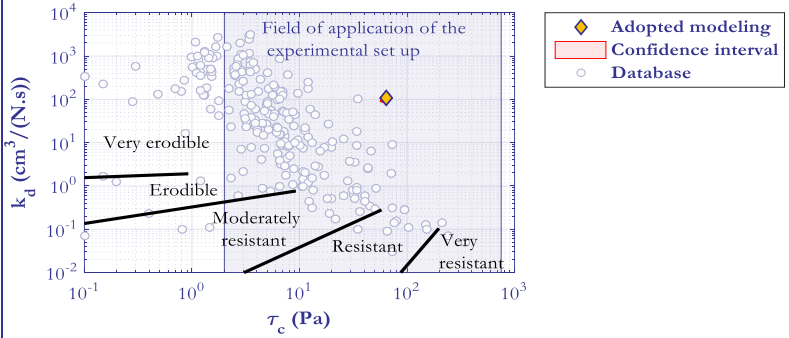
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τ_c	51	**63**	76	Pa
Hanson erosion coefficient:	kd	84	**110**	130	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		8.6		cm
Characteristic erosion time:	t95		0.3		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SXI_E1_A
Date of the test: 07/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

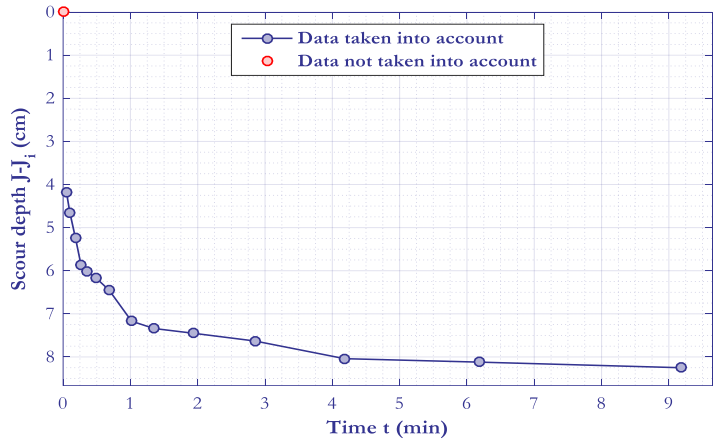
After the test

Sample type:	Intact	Water content:	23.1 %
Removed fraction:	-	Dry density:	1.24
Sample heigh:	18.0 cm	Wet density:	1.47

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



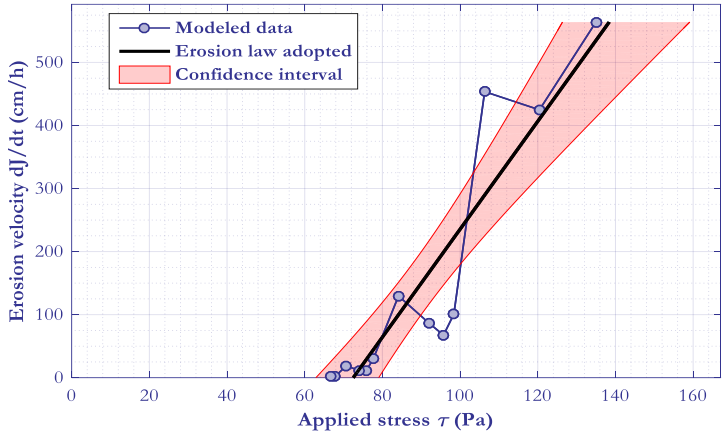
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	8.29 ± 0.11	mCe
Initial impact heigh:	Ji	4.5	cm

Observation during the test

First point not consistent with the overall trend. Not taken into account in the modeling

Test modeling

$dJ/dt = kd(\tau - \tau c)$



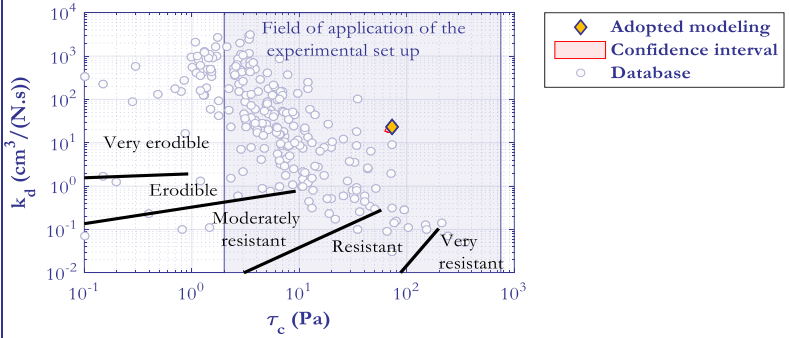
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	56	**72**	89	Pa
Hanson erosion coefficient:	kd	17	**24**	31	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		7.7		cm
Characteristic erosion time:	t95		1.0		min

Modeling remarks

No specific observation

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SXII_E1_A
Date of the test: 04/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report: geophy000367

Description of the sample

Before the test

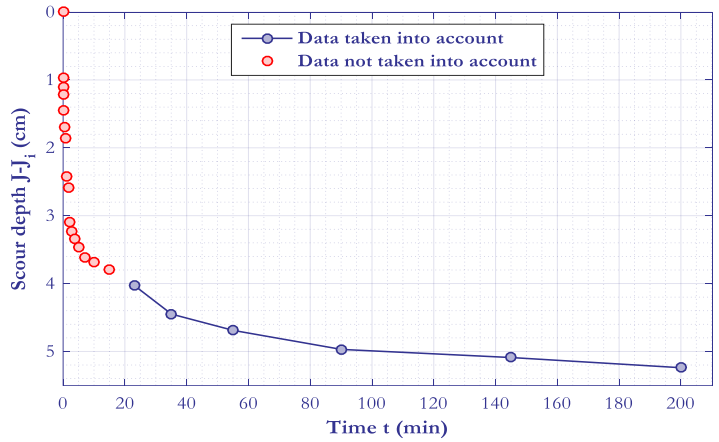
After the test

Sample type:	Intact	Water content:	21.9 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.59

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



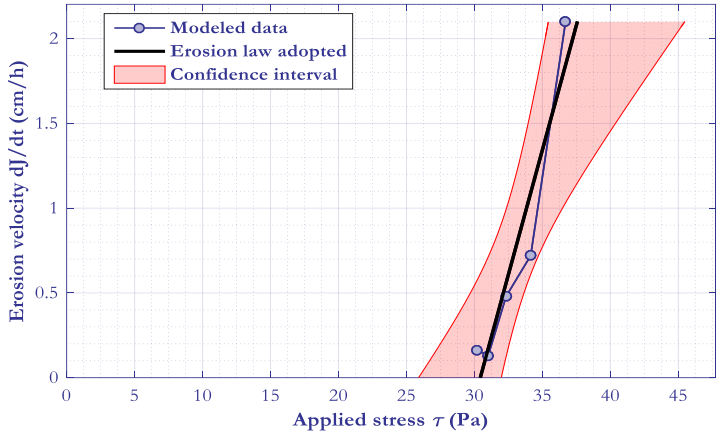
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.31 ± 0.05	mCe
Initial impact heigh:	Ji	4.8	cm

Observation during the test

First points not consistent with the overall trend. Not taken into account in the modeling.
Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



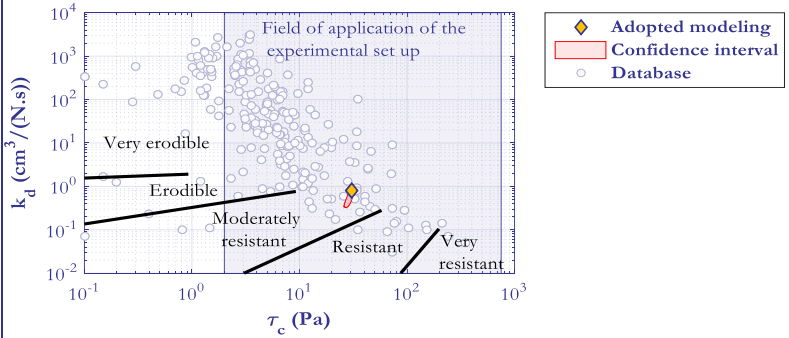
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	23	**30**	38	Pa
Hanson erosion coefficient:	kd	0.31	**0.82**	1.3	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		5.1		cm
Characteristic erosion time:	t95		55.9		min

Modeling remarks

Modeling of phase 2

Hanson classification



Overall remarks

No specific observation

Jet Erosion Test

Name of the test: SXII_E1_A
Date of the test: 04/08/2020
Project manager: Maxime Boucher
Operator: Guillaume Davion

Report:
geophy000367

Description of the sample

Before the test

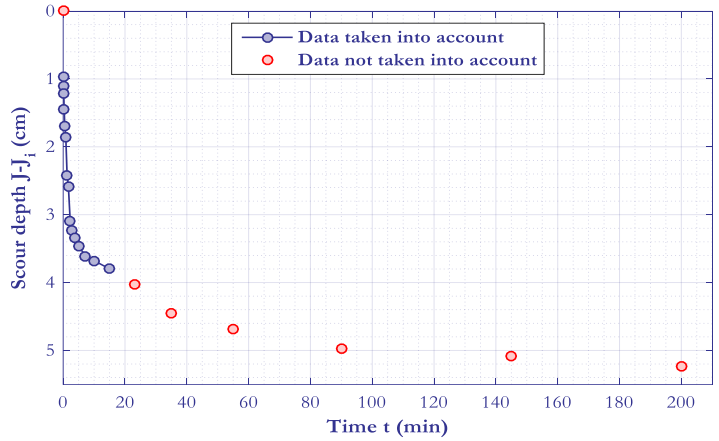
After the test

Sample type:	Intact	Water content:	21.9 %
Removed fraction:	-	Dry density:	1.35
Sample heigh:	18.0 cm	Wet density:	1.59

Observation before and after test

Presence of many roots crossing the scour profil

Progress of the test



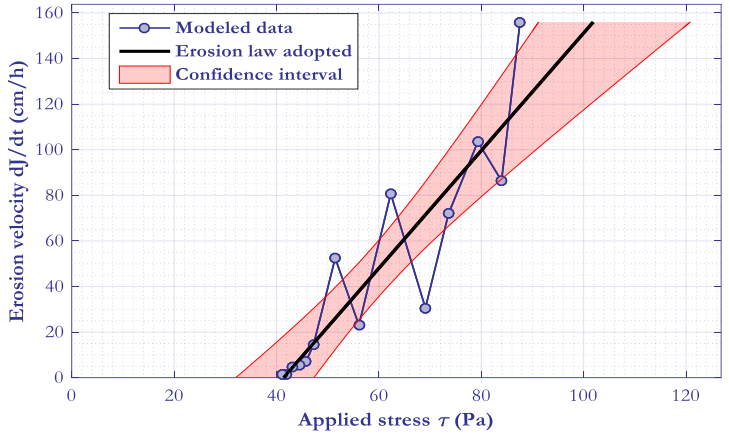
Test parameters	Symbols	Values	Units
Jet diameter:	d0	6.35	mm
Hydraulic load applied:	h	2.31 ± 0.05	mCe
Initial impact heigh:	Ji	4.8	cm

Observation during the test

First points not consistent with the overall trend. Not taken into account in the modeling.
Modelling of the test in two phases

Test modeling

$dJ/dt = kd(\tau - \tau c)$



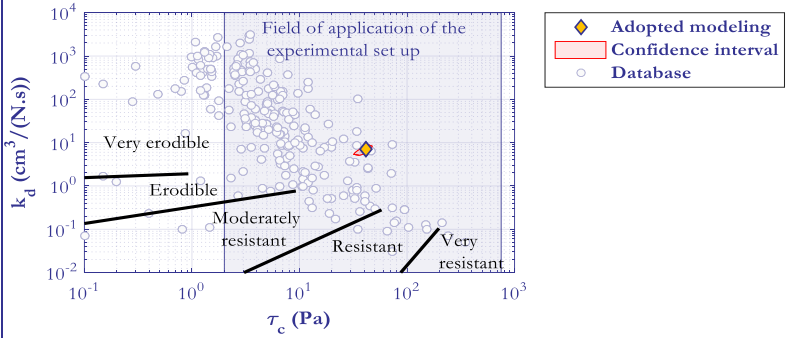
Modeling parameters	Symbols	Values	Units
Gravity acceleration:	g	9.81	m/s²
Water density:	ρ	1000	kg/m3
Diffusion coefficient:	Cd	6.3	-
Friction coefficient:	Cf	0.00416	-
Level of confidence	Nc	0.95	-

Results	Symbols	Minimum	Retained	Maximum	Units
Critical stress:	τc	28	**41**	55	Pa
Hanson erosion coefficient:	kd	5	**7.2**	9.3	cm3/(Ns)
Max. scour depth according to the model:	J∞ - Ji		3.7		cm
Characteristic erosion time:	t95		3.9		min

Modeling remarks

Modeling of phase 1

Hanson classification



Overall remarks

No specific observation