LABORATORY REPORT

Babinovsky Cement Factory

Russian Federation

Project No: 16-71045

Case No: 20180173

2018-10-30

Version: 3

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LABORATORY REPORT
Ordered by: HJ
Copies to: SQL

SAMPLE DESCRIPTION

SAMPLE NAME	SAMPLE NUMBER	WEIGHT, KG	DATE RECEIVED
Mergel/Limestone	01	2000	21-08-2018

CONTENTS OF REPORT (ANALYSES / TESTS)

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REVISION MARKS

VERSION	DESCRIPTION
1	1. edition
2	Result for impact recalculated
3	Burnability and HOR results added.

COMMENTS

Raw material VRM test:
The feed material was slightly coarser than normal, though it does not affect power consumption to any significant extent.
Also, the materials were very easy to grind, making the first two periods too fine (<2% +90µm), thus the three latter periods are used for analysis.

Material Description - Sample as received

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
01.05	Mergel/Limestone - Drum 2 of 8	Limestone	20180173-01.05

INSPECTION

Received: **02-10-2018** Container: **Drums** Weight, kg: **0,000**

☐ Material wrapped up in Plastic ☐ The material smells ☐ Material is labeled as Hazardous

MATERIAL CRUSHABILITY

☐ Very Weak - The material can be scratched by thumbnail ☑ Strong - Hand held specimens broken by single blow of hammer

☐ Weak - Knife cuts material ☐ Very Strong - Requires many blows by hammer to break

BULK MATERIAL PROPERTIES

☐ Moist ☐ Caking ☑ Dry

PROPERTY OF SAMPLE

☐ Mainly Plastic/Soft ☑ Mainly Brittle/Hard

FINES (<2mm)

Approx.: 0-30%

GRAIN-SIZE SCALE (mm)

☐ > 256	Boulders	☐ 0.1 - 2	Sand	Average size (mm)
☐ 64 - 256	Cobbles	☐ 0.004 - 0.1	Silt	**8**
☑ 4 - 64	Pebbles	☐ < 0.004	Clay	Top size (mm)
☑ 2 - 4	Granules			**160x120x25**

ADDITIONAL COMMENTS

LABORATORY SUGGESTIONS (MATERIAL CONSIDERATIONS)

☐ Flowability ☐ Max moisture ☐ Contains 10 or more specimens larger than 35 mm and is suitable for load strength

Characterization of Materials

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
01.01	Mergel/Limestone - Drum 1 of 8	Limestone	20180173-01.01
01.02	Mergel/Limestone - Drum 5 of 8	Limestone	20180173-01.02
01.03	Mergel/Limestone - Drum 4 of 8	Limestone	20180173-01.03
01.04	Mergel/Limestone - Drum 7 of 8	Limestone	20180173-01.04

PARAMETER	METHOD	UNIT	01.01	01.02	01.03	01.04
Moisture						
Moisture Content (105°C)	FLS-B21	%	2.4	2.5	2.1	2.4
Chemical analyses						
SiO_2	FLS-D02	%	8.34	8.81	8.25	7.58
Al_2O_3	FLS-D02	%	2.39	2.47	2.25	2.19
Fe_2O_3	FLS-D02	%	1.10	1.14	1.05	1.01
CaO	FLS-D02	%	47.61	46.98	47.68	48.27
MgO	FLS-D02	%	1.04	1.07	0.99	0.97
Mn_2O_3	FLS-D02	%	0.07	0.07	0.07	0.07
TiO_2	FLS-D02	%	0.17	0.17	0.16	0.15
P_2O_5	FLS-D02	%	0.04	0.05	0.05	0.04
K_2O	FLS-D02	%	0.84	0.87	0.79	0.76
Na_2O	FLS-D02	%	0.02	0.02	0.02	0.02
SrO	FLS-D02	%	0.02	0.02	0.02	0.02
SO_3	FLS-D02	%	0.04	0.04	0.04	0.03
LOI, 975 °C	FLS-D02	%	38.26	37.92	38.32	38.78
TOTAL	FLS-D02	%	99.94	99.62	99.69	99.88
Lime saturation factor (LSF)	**FLS-D02**	**%**	**177**	**166**	**180**	**197**
Silica ratio (SR)	**FLS-D02**	**-**	**2.4**	**2.4**	**2.5**	**2.4**
Alumina ratio (AR)	**FLS-D02**	**-**	**2.2**	**2.2**	**2.1**	**2.2**

Characterization of Materials

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
04	Mergel/Limestone mix of drums 1, 4, 5, 7	Limestone	20180173-04
05	Clay mix of samples 20170181-09, 12, 13	Clay	20180173-05

PARAMETER	METHOD	UNIT	04	05		
Moisture						
Moisture Content (105°C)	FLS-B21	%	1.8			
Max. Moisture						
Fraction	FLS-B22	-	-25 mm			
Fraction, +4 mm	FLS-B22	%	80			
Max. Moisture +4 mm	FLS-B22	%	5.0			
Fraction, -4 mm	FLS-B22	%	20			
Max. Moisture -4 mm	FLS-B22	%	17.7			
Max. Moisture Total	FLS-B22	%	8.1			
Density						
Fraction	-	-	-25 mm			
Moisture at test	FLS-B21	%	1.8			
Volume of can	-	L	5.47			
Bulk Density, Loose	FLS-B23	kg/m³	1425			
Bulk Density, Compacted	FLS-B23	kg/m³	1642			
Chemical analyses						
SiO_2	FLS-D02	%	8.07	64.61		
Al_2O_3	FLS-D02	%	2.22	12.30		
Fe_2O_3	FLS-D02	%	1.04	5.37		
CaO	FLS-D02	%	47.75	4.51		
MgO	FLS-D02	%	1.00	1.74		
Mn_2O_3	FLS-D02	%	0.07	0.05		
TiO_2	FLS-D02	%	0.16	0.80		
P_2O_5	FLS-D02	%	0.04	0.08		
K_2O	FLS-D02	%	0.80	2.39		
Na_2O	FLS-D02	%	0.02	0.48		
SrO	FLS-D02	%	0.02	0.04		
SO_3	FLS-D02	%	0.04	0.05		
LOI, 975 °C	FLS-D02	%	38.43	7.48		
TOTAL	FLS-D02	%	99.65	99.88		
Chloride	FLS-D07	%	0.007			
Lime saturation factor (LSF)	**FLS-D02**	**%**	**184**	**2**		
Silica ratio (SR)	**FLS-D02**	**-**	**2.5**	**3.7**		
Alumina ratio (AR)	**FLS-D02**	**-**	**2.1**	**2.3**		

Impact Test

SAMPLE DESCRIPTION			
ID	*SAMPLE NAME*	*MATERIAL TYPE*	*SAMPLE NUMBER*
04	**Mergel/Limestone mix of drums 1, 4, 5, 7**	**Limestone**	**20180173-04**

PARAMETER		UNIT	RESULT
Summary			
Fraction		mm	8 - 16
Velocity		m/s	40
Wear		g/t	0.6
		g/kWh	1.2
Power Consumption		kWh/t	0.51
Circulation Factor			2.3
Particle Size Distribution for Product (-4 mm fraction)			
K50		mm	2.0
Relative gradient			0.98
Sieve Residues			
3.15	mm	%	21.4
2	mm	%	50.7
1	mm	%	76.0
500	µm	%	87.2
250	µm	%	92.3
200	µm	%	92.9
90	µm	%	95.6

Images of sample and wear plate

Atox

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE		SAMPLE NUMBER
02	Raw Mix for ATOX Test	Raw Mix, Mill test		20180173-02
Mixed of:				
04	Mergel/Limestone mix of drums 1, 4, 5, 7	Limestone	89.55 %	20180173-04
05	Clay mix of samples 20170181-09, 12, 13	Clay	10.45 %	20180173-05

PARAMETER	METHOD	UNIT	RESULT
Millfeed			
Moisture	FLS-B21	%	3.60
Residue, 8 mm	Gilson	%	28.3
Residue 4 mm	Gilson	%	60.4
Residue, 2 mm	Gilson	%	77.4
Residue, 1 mm	Machine	%	86.5
Residue, 500 µm	Machine	%	91.5
Residue, 250 µm	Machine	%	94.2
Residue, 200 µm	Alpine	%	94.6
Residue, 90 µm	Alpine	%	96.6
Mill			
Revolutions	FLS-I18	rpm	100
Hydraulic pressure	FLS-I18	bar	90
Grinding force	FLS-I18	kN	26
Grinding pressure	FLS-I18	kN/m²	596
Gas			
Quantity	FLS-I18	m³/h	996
Temperature out	FLS-I18	°C	91

Atox

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02	Raw Mix for ATOX Test	Raw Mix, Mill test	20180173-02

PARAMETER	METHOD	UNIT					
Period			***1***	***2***	***3***	***4***	***5***
Separator: Static	FLS-I18	º	28	25	23		
Dyn. press.	FLS-I18	mmWg	231	229	230		
Grinding bed							
Average for rollers	FLS-I18	mm	5.7	6.7	7.3		
Power consumption							
Electric Power	FLS-I18	kW	3.80	4.11	4.24		
Specific Power Consumption	FLS-I18	kWh/t	4.42	4.03	3.79		
Production							
Total	FLS-I18	kg	28.2	33.7	36.9		
Rate	FLS-I18	t/h	0.859	1.018	1.118		
Sieve residue							
90 µm	Alpine	%	7.9	11.7	17.9		
200 µm	Alpine	%	0.5	1.6	4.7		
Grinding constants							
90 µm	FLS-I18	kWh/t	4.06	4.39	5.17		
200 µm	FLS-I18	kWh/t	1.97	2.28	2.92		
µ-Factor	FLS-I18		0.099	0.107	0.110		
Test time	FLS-I18	h	1.07				
Avg. Electric Power	FLS-I18	kW	4.05				
Ground mat.	FLS-I18	t	0.869				
Product properties							
Sieving Residue on 90 µm	Alpine	%	12.9				
Moisture		%	0.49				
Abrasion			***g***	***g***	***g/t***	***g/h***	***g/kWh***
Table Cromin 15	FLS-I18			0.2			
Roller 1 Cromin 15	FLS-I18		0.1				
Roller 2 Cromin 15	FLS-I18		0.1				
Roller 3 Cromin 15	FLS-I18		0.1				
Total rollers	FLS-I18			0.3	0.3	0.3	0.1
Total Abrasion	FLS-I18			0.5	0.6	0.5	0.1

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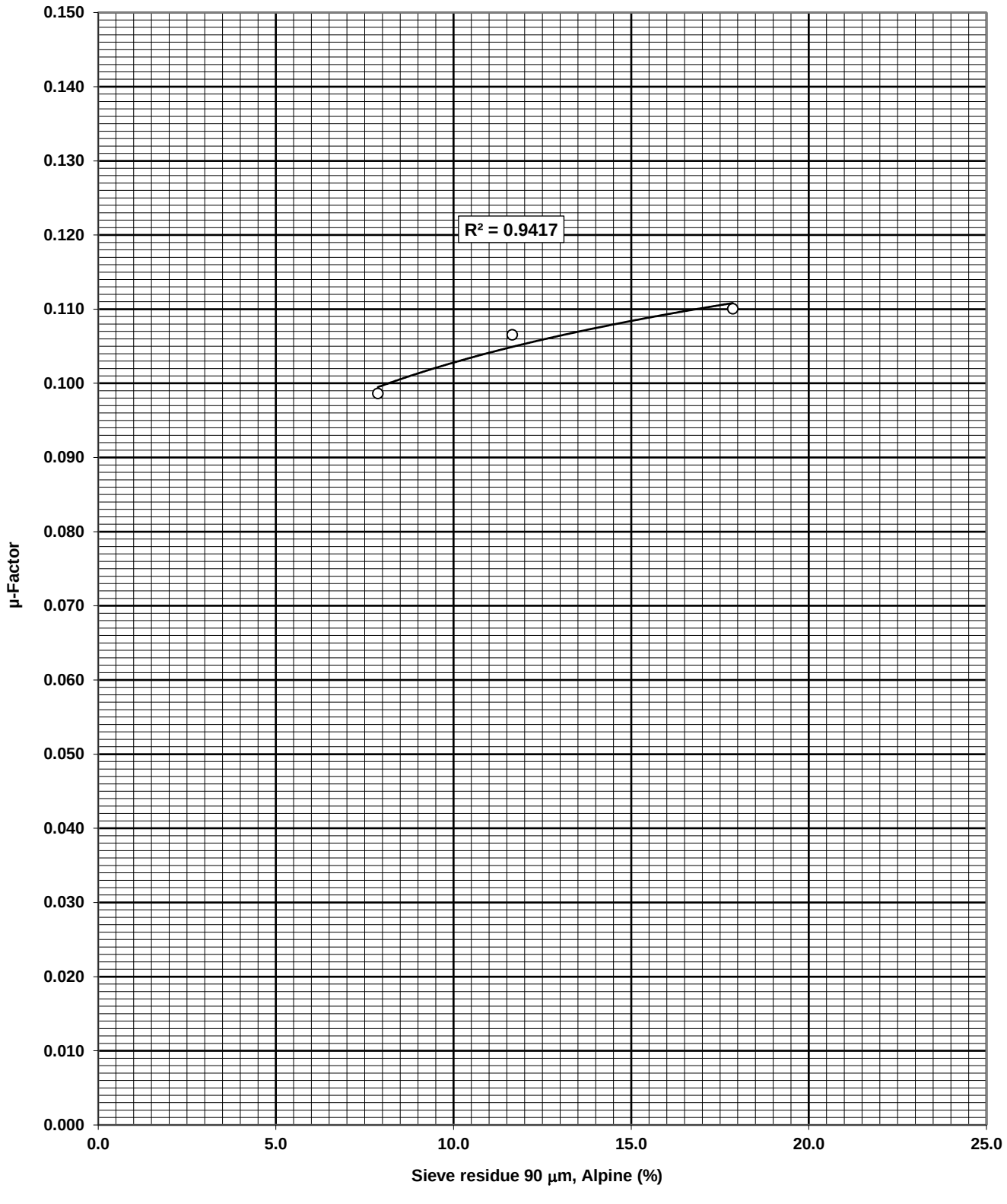
SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02	Raw Mix for ATOX Test	Raw Mix, Mill test	20180173-02

µ-factor vs. Sieve residue on 90µm, logarithmic trend.



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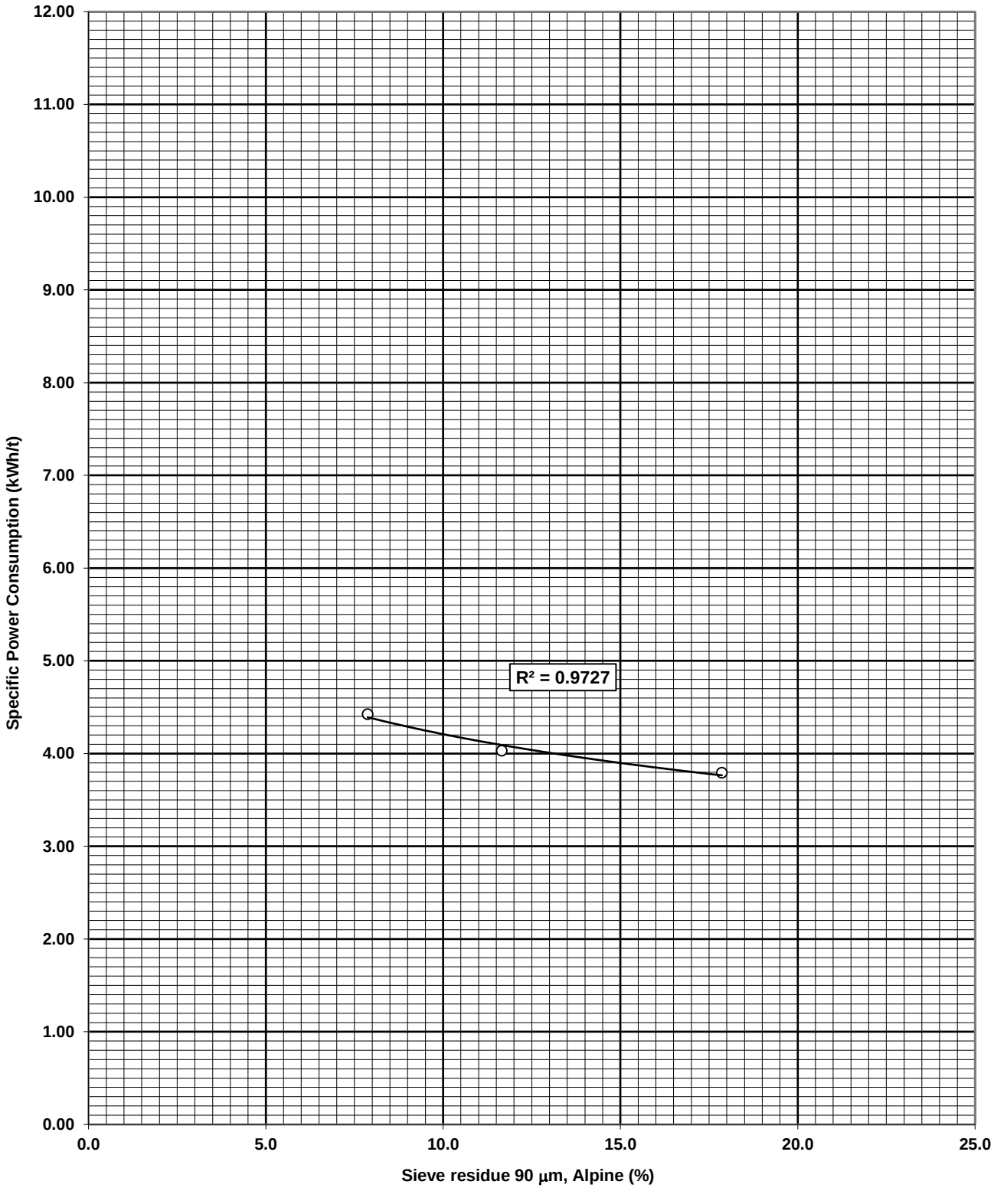
SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02	Raw Mix for ATOX Test	Raw Mix, Mill test	20180173-02

Specific power consumption rate vs. Sieve residue on 90 µm, logarithmic trend.



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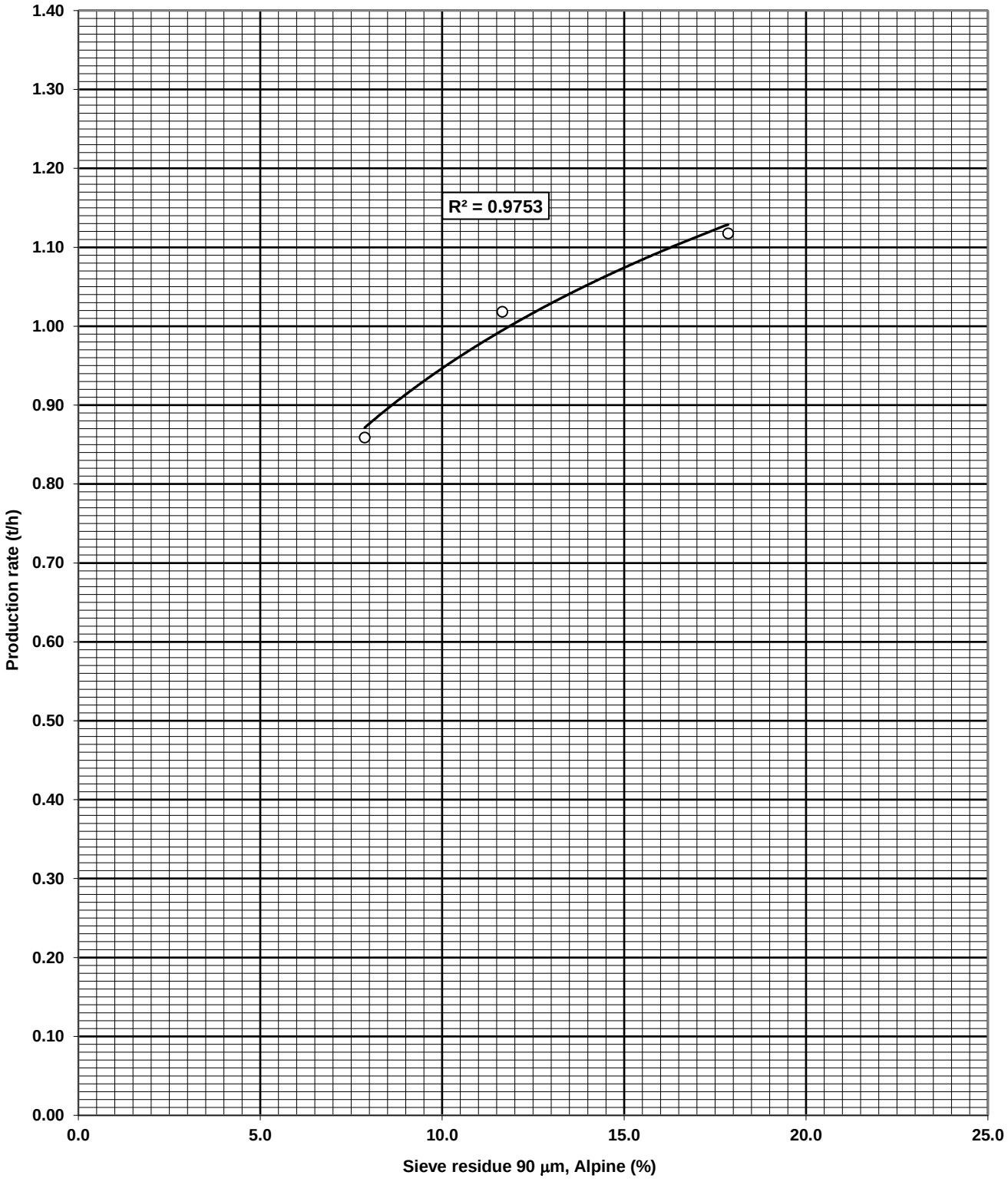
SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02	Raw Mix for ATOX Test	Raw Mix, Mill test	20180173-02

Production rate vs. Sieve residue on 90 µm, logarithmic trend.



Atox Products

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02.01	ATOX, Product	Raw Meal	20180173-02.01
02.02	ATOX, Fine Fraction	Raw Meal	20180173-02.02
02.03	ATOX, Separator Return	Raw Meal	20180173-02.03

PARAMETER	METHOD	UNIT	02.01	02.02	02.03
Fineness					
Residue, 2 mm, machine	MACHINE	%			0.0
Residue, 1 mm, machine	MACHINE	%			0.4
Residue, 500 µm, machine	MACHINE	%			9.7
Residue, 250 µm, machine	MACHINE	%			44.6
Residue, 200 µm, alpine	ALPINE	%	1.6		52.4
Residue, 90 µm, alpine	ALPINE	%	11.9		83.3
Residue, 45 µm, alpine	ALPINE	%	24.4		92.2
Residue, 32 µm, alpine	ALPINE	%	29.2		
Erosive Wear Test					
Relative Wear Rate		%			2
Relative Wear Rate, STD		%			0.6
Air pressure	FLS-I20	bar			4.0
Angle of Incidence	FLS-I20	°			30
Temperature	FLS-I20	°C			20
Erodent Material	FLS-I20	-			Sep.Return
Target Material	FLS-I20	-			St37
Wear Classification	**FLS-I20**	**-**			**Low**
Density					
Bulk Density, Loose	FLS-B26	kg/m³	921		
Bulk Density, Compacted	FLS-B26	kg/m³	1242		
Standard Silo Test					
Stress at Loose Bulk Density	FLS-B27	MPa	0.00031		
Stress at Packed Bulk Density	FLS-B27	MPa	0.06668		
Material Compressibility	**FLS-B27**	**-**	**0.0556**		
Bulk density at Silo Height	FLS-B27	m	60		
- Bulk density at 25% Silo filling	FLS-B27	kg/m³	1241		
- Bulk density at 50% Silo filling	FLS-B27	kg/m³	1292		
- Bulk density at 75% Silo filling	FLS-B27	kg/m³	1323		
- Bulk density at 100% Silo filling	FLS-B27	kg/m³	1346		

Atox Products

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02.01	ATOX, Product	Raw Meal	20180173-02.01
02.02	ATOX, Fine Fraction	Raw Meal	20180173-02.02
02.03	ATOX, Separator Return	Raw Meal	20180173-02.03

PARAMETER	METHOD	UNIT	02.01	02.02	02.03
Chemical analyses					
SiO_2	FLS-D02	%	14.32	10.96	10.94
Al_2O_3	FLS-D02	%	3.37	3.10	2.63
Fe_2O_3	FLS-D02	%	1.53	1.42	1.18
CaO	FLS-D02	%	42.90	45.10	45.82
MgO	FLS-D02	%	1.11	0.97	0.88
Mn_2O_3	FLS-D02	%	0.07	0.07	0.07
TiO_2	FLS-D02	%	0.23	0.21	0.18
P_2O_5	FLS-D02	%	0.05	0.05	0.04
K_2O	FLS-D02	%	0.99	0.90	0.74
Na_2O	FLS-D02	%	0.07	0.05	0.05
SrO	FLS-D02	%	0.02	0.02	0.02
SO_3	FLS-D02	%	0.04	0.04	0.04
LOI, 975 °C	FLS-D02	%	35.01	36.65	36.99
TOTAL	FLS-D02	%	99.70	99.54	99.58
Free Silica	FLS-D52	%	7	7	6
Lime saturation factor (LSF)	**FLS-D02**	**%**	**95**	**128**	**133**
Silica ratio (SR)	**FLS-D02**	**-**	**2.9**	**2.4**	**2.9**
Alumina ratio (AR)	**FLS-D02**	**-**	**2.2**	**2.2**	**2.2**

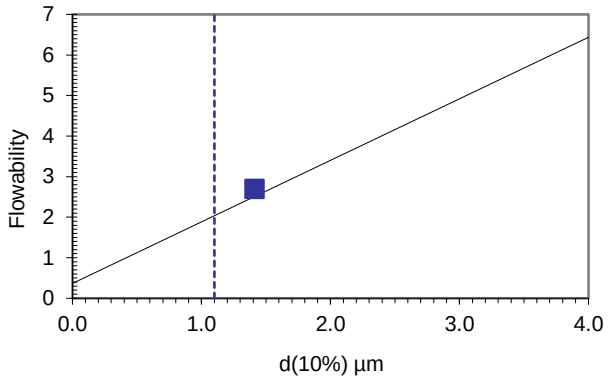
Raw Meal Characterization

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
02.01	ATOX, Product	Raw Meal	20180173-02.01

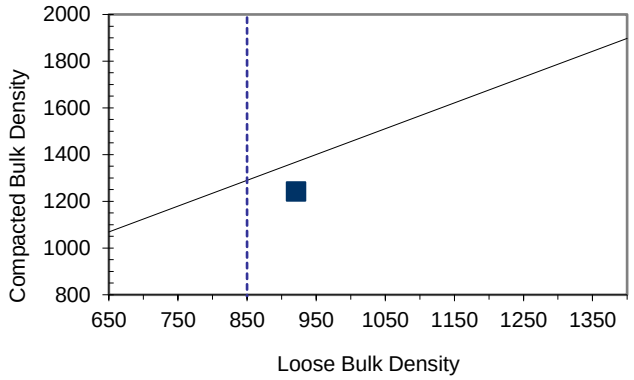
PARAMETER	METHOD	UNIT	RESULT
Particle Size Distribution (Laser diffractometry)			
d(10%)	FLS-F02	µm	1.41
Shear Tester (ASTM D6773-02)			
Major principial strength (σ_1)	FLS-B36	Pa	7941
Unconfined yield strength (σ_c)	FLS-B36	Pa	2908
Flowability (ff_c)	FLS-B36		2.70
Bulk Density at Shear (ρ_b)	FLS-B36	kg/m^3	1196
Effective angle of internal friction (φ_e)	FLS-B36	°	44.0
Bulk Density (DIN 53.194)			
Loose	FLS-B26	kg/m^3	921
Compacted	FLS-B26	kg/m^3	1242

Flowability vs d(10%)



The graph illustrates the relation beteween flowability and particle size distribution.
The inserted solid line presents the correlation based on empirical work.
The flowability is highly effected by the particle size distribution, mainly d(10%).

Compacted vs Loose Density

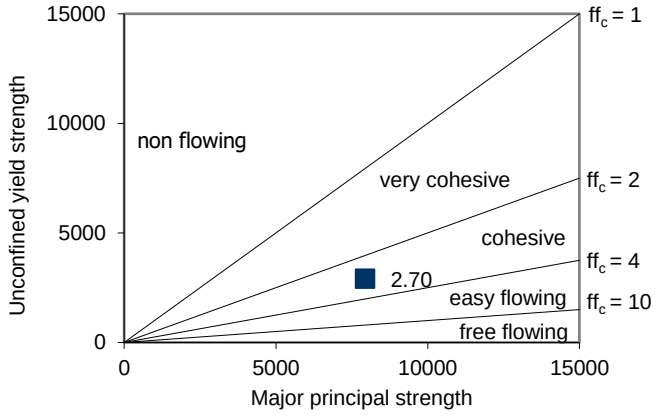


In the graph the Compacted Bulk Density is plotted versus the Loose Bulk Density.
The inserted solid line presents the correlation based on empirical work.

Flowability

The flow behavior can be classified by the flowability ffc = σ1/σc. The larger the flowability ffc, the better a bulk solid flows. The following classification defines the flowability:

$ff_c < 1$	Non flowing
$1 < ff_c < 2$	Very cohesive
$2 < ff_c < 4$	Cohesive
$4 < ff_c < 10$	Easy-flowing
$10 < ff_c$	Free-flowing



Raw Mix Calculation

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
03	Raw Mix for burnability and H.O.R.	Raw Mix	20180173-03

Mix 2	Clinker	Mix	M01	M02	M03	F01	A01
Mix [% dry]		100.00	87.60	10.56	1.85	0.00	
Mix [as analysed % wet]		100.00	87.32	10.33	2.35	0.00	
Mix [as fired % wet]						0.00	
H2O (analysed) [% (wb)]		2.12	1.80	0.00	23.20	0.00	
H2O (as fired) [% (wb)]						0.00	
SiO2 [%]	21.52	14.09	8.07	64.61	11.00		
Al2O3 [%]	5.01	3.28	2.22	12.30	2.08		
Fe2O3 [%]	3.33	2.18	1.04	5.37	38.09		
CaO [%]	64.93	42.51	47.75	4.51	11.20		
MgO [%]	1.66	1.09	1.00	1.74	1.52		
Mn2O3 [%]	0.29	0.19	0.07	0.05	6.67		
TiO2 [%]	0.58	0.38	0.16	0.80	8.32		
P2O5 [%]	0.07	0.04	0.04	0.08	0.03		
K2O [%]	1.46	0.95	0.80	2.39	0.08		
Na2O [%]	0.11	0.07	0.02	0.48	0.10		
SrO [%]	0.03	0.02	0.02	0.04			
SO3 [%]	0.41	0.27	0.04	0.05	12.23		
S [%]		0.00					
LOI [%]		34.52	38.43	7.48	3.78		
Total [%]	99.39	99.60	99.66	99.90	95.10		0.00
S Total [%]	0.16	0.11	0.02	0.02	4.90		
S Pyrite [%]		0.00					
Cl- [%]	0.010	0.006	0.007		0.008		
F- [%]	0.00	0.00					
Ash [%]	0.00						
Hi (analysed) [kcal/kg]							
Exp kiln heat cons [kcal/kg]	750.00						
LSF [%]	95.0	95.0	184.4	2.3	19.3		
MS	2.58	2.58	2.48	3.66	0.27		
MA	1.50	1.50	2.13	2.29	0.05		
Na2O eq. [%]	1.07	0.70	0.55	2.05	0.15		
K2O eq. [%]	1.62	1.06	0.83	3.12	0.23		
C3S [%]	62.34		M01: 20180173-04 Mergel/Limestone mix drums 1,4,5,7				
C2S [%]	14.67		M02: 20180173-05 Clay mix from 20170181-09, 12, 13				
C3A [%]	7.65		M03: 20170116-42.01 Iron additive				
C4AF [%]	10.14		F01: F01				
C2F [%]	0.00						
Free CaO [%]	0.00						
Liquid phase 1450 °C [%]	26.16						
Liquid phase 1338 °C [%]	23.95						
M SO3	0.31						
Excess SO3 [g/100 kg]	0						
Excess Na2O equivalents [%]	0.75						

Burnability Test

SAMPLE DESCRIPTION			
ID	*SAMPLE NAME*	*MATERIAL TYPE*	*SAMPLE NUMBER*
03	Raw Mix for burnability and H.O.R.	Raw Mix	20180173-03

PARAMETER	METHOD	UNIT	03		
Characterization of Raw Mix					
Fluoride	FLS-D34	%	<0.03		

PARAMETER	METHOD	UNIT	Coarse	Medium	Fine
Fineness on Raw Mix					
Residue, 200 µm, alpine	ALPINE	%			0.4
Residue, 200 µm, wet	WET	%	1.9	1.0	0.4
Residue, 125 µm, wet	WET	%			3.2
Residue, 90 µm, wet	WET	%	18.8	14.2	9.6
Residue, 90 µm, alpine	ALPINE	%	19.5	14.7	9.9
Residue, 45 µm, wet	WET	%			23.6
Burnability test on Raw Mix					
Free CaO after burning at 1400 °C	FLS-D23	%	1.3	1.2	0.9
Free CaO after burning at 1450 °C	FLS-D23	%	1.0	0.9	0.8
Free CaO after burning at 1500 °C	FLS-D23	%	0.9	0.8	0.7
Burnability Index	**FLS-D23**	**-**	**43**	**39**	**32**
Burnability Classification	**FLS-D23**	**-**	**EASY**	**EASY**	**EASY**

Heat of reaction

SAMPLE DESCRIPTION

ID	SAMPLE NAME	MATERIAL TYPE	SAMPLE NUMBER
03	Raw Mix for burnability and H.O.R.	Raw Mix	20180173-03

PARAMETER	UNIT	*	RESULT	PARAMETER	UNIT	RESULT
Raw mix				***Fuel: Gas***		
SiO_2	%		14.09	Fuel in percentage of clinker	%	
Al_2O_3	%		3.28	Sulphur, total	%	
Fe_2O_3	%		2.18	Ash in percentage of fuel	%	
CaO	%		42.51	Net calorific value ($Q_{net,p}$)	kJ/kg	
MgO	%		1.09		kcal/kg	
SO_3 (Acid soluble sulphur)	%	*	0.23	Heat consumption, clinker	kJ/kg	3140
Loss on ignition (LOI)	%		34.52		kcal/kg	750
TOTAL	%		97.90	***Analysis of ash***		
CO_2	%	*	33.60	SiO_2	%	
K_2O	%		95.00	Al_2O_3	%	
Na_2O	%		0.07	Fe_2O_3	%	
Sulphur, total	%		0.11	CaO	%	
Water of crystallisation	%	*	0.91	MgO	%	
Carbon [1)]	%	*	0.07	K_2O [2)]	%	
				Na_2O [2)]	%	
CALCULATED VALUES						
$CaCO_3$	%		75.62	$CaSO_4$	%	0.39
$MgCO_3$	%		0.62	Silica-combined CaO	%	0.00
Sulphur in pyrites	%		0.02			

RAW MIX ADJUSTMENT

PARAMETER	UNIT	RAW MIX	ADJUSTMENT FUEL	ADJUSTED RAW MIX	
SiO_2	%	14.09	0.00		14.09
Al_2O_3	%	3.28	0.00		3.28
Fe_2O_3	%	2.18	0.00		2.18
CaO	%	42.51	0.00		42.51
MgO	%	1.09	0.00		1.09
SO_3	%	0.28	0.00		0.28
K_2O	%	95.00	0.00		95.00
Na_2O	%	0.07	0.00		0.07
TOTAL	%	158.50	0.00	**T =**	158.50

SULPHUR BALANCE AND RAW MIX / CLINKER RATIO

Adjusted raw mix, total :			**T :**	158.50
Volatilised : U =	50	% of sulphur in pyrites as SO_3	**U :**	0.02
SO_3 in clinker (calculated) :				0.16
Raw mix / clinker ratio	(loss of dust = 0 %) : F = 100 / (T – U) :		**F :**	0.63

Remarks:

* Analytical results

1) Carbon as CO_2 is not included.

2) Calculated from analysis of solid fuel.

Heat of reaction

CALCULATIONS	Content %	Conversion factors kJ / kg / %	RAWMIX kJ / kg		CLINKER kJ / kg
Heat of decomposition					
	RAWMIX				
$CaCO_3$	75.62	-17.78	-1345		
$MgCO_3$	0.62	-15.10	-9		
Water of crystallisation	0.91	-42.70	-39		
Silica-combined MgO	0.79	-10.00	-8		
Silica-combined CaO	0.00	-17.00	0		
Alkali silicates (K_2O + Na_2O)	95.07	-14.80	-1407		
Heat of decomposition (A):			-2808	**xF:**	-1772
Heat of formation					
Property Component	Adj. RAWMIX				
C_3S CaO	42.51	-0.46	-20		
C_2S SiO_2	14.09	21.43	302		
C_3A Al_2O_3	3.28	1.21	4		
C_4AF Fe_2O_3	2.18	2.46	5		
SO_3 from fuel and pyrites	0.02	59.60	1		
Heat of formation (B):			293	**xF:**	185
Heat of combustion					
Carbon	0.07	327.86	23		
Sulphur in pyrites	0.02	129.14	2		
Heat of combustion (C):			25	**xF:**	16
Heat of reaction					
HEAT OF REACTION (A + B + C):			(kJ / kg clinker)		-1571
			(kcal / kg clinker)		-375
HEAT OF REACTION excl. HEAT OF COMBUSTION (A + B):			(kJ / kg clinker)		-1587
			(kcal / kg clinker)		-379