HQS-A huaqiansu

—— Admixture for lean production of cement-based grouting materials

Uses

HQS-A huaqiansu is an admixture for cement grouting material where a reduced water/cement ratio,early strength,high strength,vertical expansion and winter construction is required.Applications include equipment foundation grouting, bed grouting,duct grouting,non-shrink infilling,sleeve grouting and foundation grouting of wind turbine in wind farm,etc.

Advantages

- **High fluidity:**Gives high grout fluidity with low water/cement ratio,thus making placement or injection of the grout easy.
- **Expansion rate:**Gaseous expansion system compensates for plastic shrinkage and settlement in properly designed cement grouting material.
- **High early strength：** composition allows high early strength development in grouts,without the use of chlorides.
- **Stability:**No metallic iron content to corrode and cause staining or deterioration due to rust expansion in the grout.
- **Impermeability:**reduced water/cement ratio mixes in the grout mix ensures low permeability and long term durability in service.
- **Winter construction：** Suitable for winter construction under - 10 ℃ ambient temperature.

Description

HQS-A huaqiansu is supplied as a powder admixture.the material is a combination of a plasticising agent and a gas producing expansion medium.The plasticising agent allows the use of a reduced water/cement ratio with consequent increased strengths and durability.The expansive medium counteracts the natural settlement and plastic shrinkage of the grout and aids stability and cohesion.

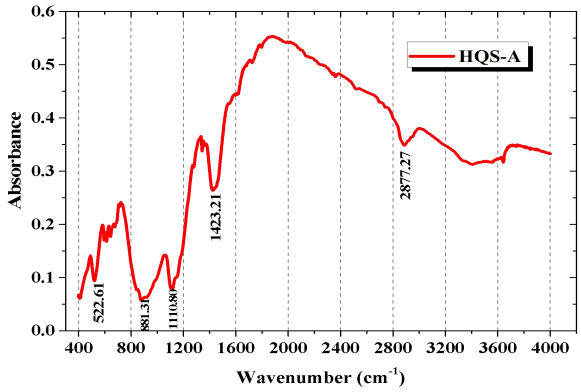
Basic test

■Infrared spectrum analysis

Preparation of test blocks： HQS-A huaqiansu sample+Potassium bromide mixture（1:3 scale）→grind（Particles less than 25μm）→Tabletting（10～20Mpa）.

Test instrument：FTIR-650 Fourier infrared spectrometer.

Measured infrared spectrogram:

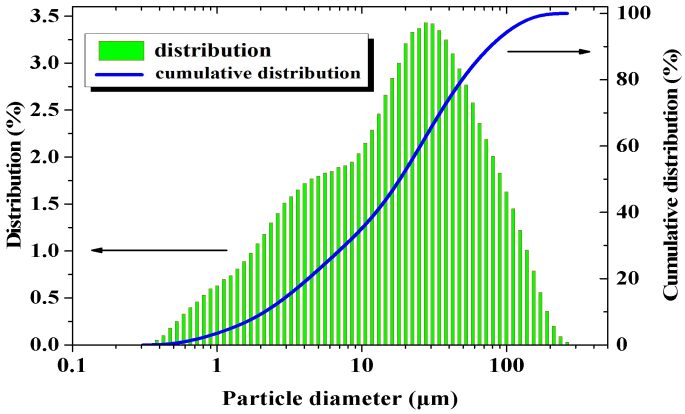


Sulfonic S-O telescopic vibration absorption point is at 1110.8 cm^{-1}, methylene symmetric stretching vibration point is at 2877.27 cm^{-1}, the symmetric telescopic vibration point of C=O is at 1423.21 cm^{-1}.

■Laser particle size analysis

Test instrument:BT-2001 laser particle size distribution instrument.

Measured particle size distribution diagram:



The particle size ranges from 0.291μm to 275.8μm, 2.2433μm-81.16μm in range account for 80%,the median diameter is 19.28μm.

■Determination of specific surface area

Test instrument:SBT-127 digital display Buchner specific surface area meter.

Measured specific surface area:460m^2/kg.

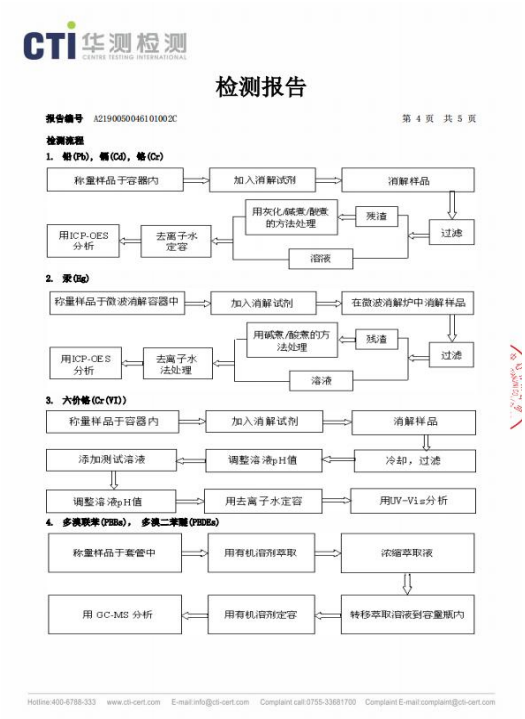
■Detection of hazardous substances

detection result:Free of heavy metals, halogenated hydrocarbons, benzene series, formaldehyde, VOC and other harmful substances.


CTI 华测检测
CMA 160220340035
检测报告
报告编号 A2190050046101002C 第 1 页 共 5 页
申请单位 北京华千新技术有限公司
地 址 北京市昌平区回龙观镇朱辛庄323号农业服务中心院内华千办公楼208
以下测试之样品及样品信息由申请者提供并确认
样品名称 华千素
样品接收日期 2019. 03. 12
样品检测日期 2019. 03. 12-2019. 03. 13
检测要求 根据客户要求，对所提交样品中的铅(Pb)，镉(Cd)，汞(Hg)，六价铬(Cr(VI))，多溴联苯(PBBs)，多溴二苯醚(PBDEs)进行测试。
检测依据 请参见下页。
检测结果 请参见下页。
李立颖
于茜
技术经理
天津华测检测产品检测中心有限公司
审 核 朱静
日 期 2019.03.13
No. R19371618
天津市东丽区先锋东路99号


CTI 华测检测
检测报告
报告编号 A2190050046101002C 第 2 页 共 5 页
检测依据

测试项目	测试方法	测试仪器
铅(Pb)	IEC 62321-5:2013	ICP-OES
镉(Cd)	IEC 62321-5:2013	ICP-OES
汞(Hg)	IEC 62321-4:2013+AMD1:2017 CSV	ICP-OES
六价铬(Cr(VI))	IEC 62321-7-2:2017和/或IEC 62321-5:2013 测试总铬含量	UV-Vis/ICP-OES
多溴联苯(PBBs)	IEC 62321-6:2015	GC-MS
多溴二苯醚(PBDEs)	IEC 62321-6:2015	GC-MS



检测报告

报告编号 A21900500461010002C 第 4 页 共 5 页

检测流程

1. 铅(Pb)，镉(Cd)，铬(Cr)

称量样品于容器内 → 加入消解试剂 → 消解样品 → 过滤 → 残渣 → 用灰化/碱煮/酸煮的方法处理 → 溶液 → 去离子水定容 → 用ICP-OES分析

2. 汞(Hg)

称量样品于微波消解容器中 → 加入消解试剂 → 在微波消解炉中消解样品 → 过滤 → 残渣 → 用碱煮/酸煮的方法处理 → 溶液 → 去离子水法处理 → 用ICP-OES分析

3. 六价铬(Cr(VI))

称量样品于容器内 → 加入消解试剂 → 消解样品 → 冷却，过滤 → 调整溶液pH值 → 用去离子水定容 → 用UV-Vis分析 → 添加测试溶液 → 调整溶液pH值

4. 多溴联苯(PBBs)，多溴二苯醚(PBDEs)

称量样品于萃管中 → 用有机溶剂萃取 → 浓缩萃取液 → 转移萃取液到容量瓶内 → 用有机溶剂定容 → 用GC-MS分析

检测报告

报告编号 A21900500461010002C 第 5 页 共 5 页

样品图片

*** 报告结束 ***

声明：

1. 检测报告无批准人签字、专用章及报告骑缝章无效；
2. 样品及样品信息由申请者提供，申请者应对其真实性负责，CTI未核实其真实性；
3. 本报告检测结果仅对受测样品负责；
4. 未经CTI书面同意，不得部分复制本报告。

■Determination of composition

See the following table for test results:

Spectrogram	C	O	Na	Mg	Al	Si	S	Cl	K	Ca	Ti	Fe	Total
001	20.57	18.05	0.34	1.40	5.21	6.41	3.46	0.51	1.11	37.98	0.59	4.37	100
001	18.53	17.24	0.60	1.19	5.49	7.04	3.19	0.59	1.35	39.92	0.44	4.42	100

检测报告

报告编号 A21901341271010001C 第 1 页 共 6 页

申请单位 北京华千新技术有限公司

地 址 北京市昌平区回龙观镇朱辛庄 323 号农业服务中心院内华千办公楼 208

以下测试之样品及样品信息由申请者提供并确认

样品名称 华千素

型号 HQS-A

样品接收日期 2019.06.03

样品检测日期 2019.06.03-2019.06.11

检测要求

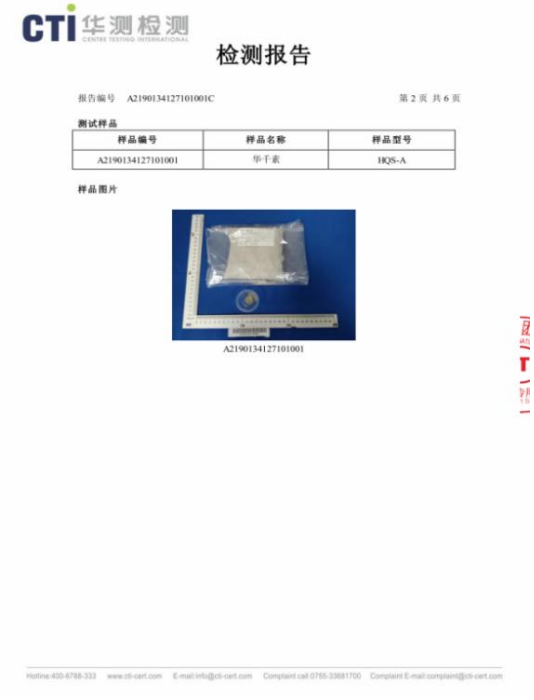
序号	测试项目
1	SEM/EDS 分析
2	XRD 分析

检测结果：请参见后续页面。

批 准 万自成 日 期 2019.06.13

No. R576F1CD28

广东省深圳市宝安区 70 区鸿威工业园



检测报告

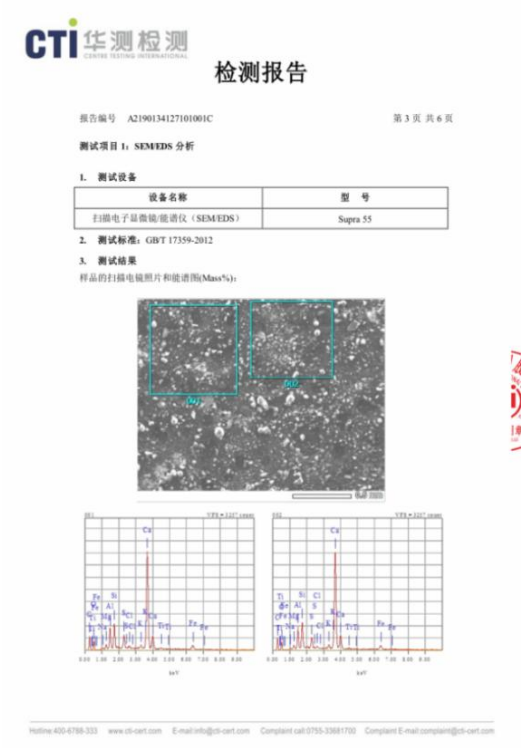
报告编号 A21901341271010001C 第 2 页 共 6 页

测试样品

样品编号	样品名称	样品型号
A21901341271010001	华千素	HQS-A

样品图片

A21901341271010001



检测报告

报告编号 A2190134127101001C 第 3 页 共 6 页

测试项目 1：SEM/EDS 分析

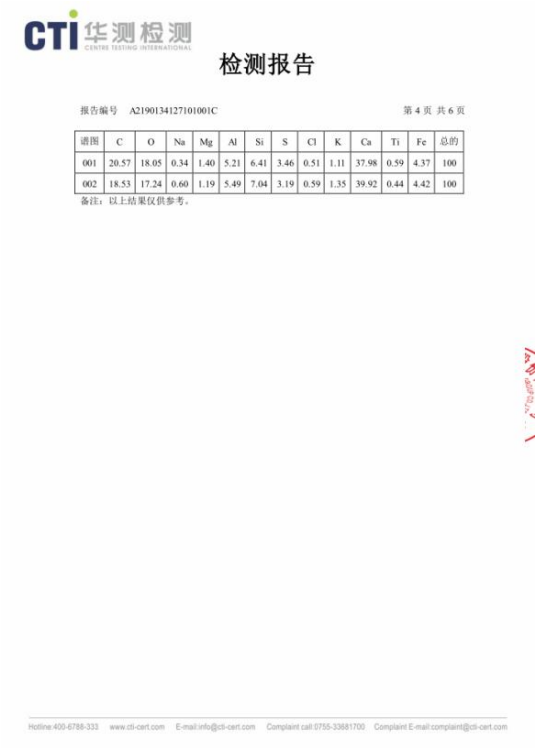
1. 测试设备

设备名称	型 号
扫描电子显微镜/能谱仪（SEM/EDS）	Supra 55

2. 测试标准：GB/T 17359-2012

3. 测试结果

样品的扫描电镜照片和能谱图(Mass%)：



检测报告

报告编号 A2190134127101001C 第 4 页 共 6 页

谱图	C	O	Na	Mg	Al	Si	S	Cl	K	Ca	Ti	Fe	总的
001	20.57	18.05	0.34	1.40	5.21	6.41	3.46	0.51	1.11	37.98	0.59	4.37	100
002	18.53	17.24	0.60	1.19	5.49	7.04	3.19	0.59	1.35	39.92	0.44	4.42	100

备注：以上结果仅供参考。

检测报告

报告编号 A2190134127101001C 第 5 页 共 6 页

测试项目 2：XRD 分析

1. 测试设备

设备名称	型 号
X 射线衍射仪(XRD)	Smartlab3KW-全自动智能型

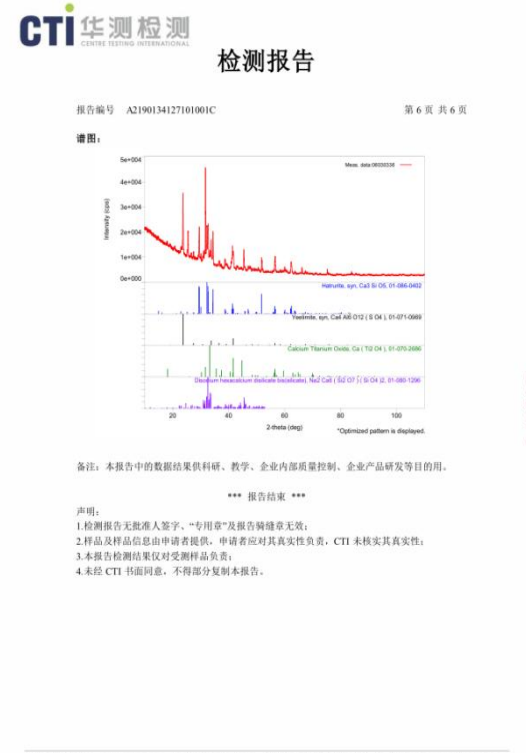
2. 测试标准：JIS K0131-1996

3. 测试结果

物相名称	分子式	数据库卡号	含量(%)
Hatrurite, syn	Ca3SiO5	01-086-0402	8.36(11)
Yeelimite, syn	Ca4Al6O12(SO4)	01-071-0969	1.38(4)
Calcium Titanium Oxide	Ca(TiO4)	01-070-2686	9.52(9)
Disodium hexacalcium disilicate bis(silicate)	Na2Ca6(Si2O7)(SiO4)2	01-080-1296	81(7)

备注：不同材料的检出限不同，结果仅供参考。

括号内数值表示通过 PDXL 软件进行分析后得到的偏差程度，例如 12.345(6)表示 12.345±0.006。



检测报告

报告编号 A2190134127101001C 第 6 页 共 6 页

谱图：

备注：本报告中的数据结果供科研、教学、企业内部质量控制、企业产品研发等目的用。

*** 报告结束 ***

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3.本报告检测结果仅对受测样品负责；

4.未经 CTI 书面同意，不得部分复制本报告。

Dosage

The dosage is 3-5% of the weight of cement,drastic over-dosing of HQS-A huaqiansu increases expansion and may cause frothing.

Formulation technology of cement-based grouting materials

According to the current national standard GB/T 50448-2015 <Technical Specification for Application of Cement-based Grouting Materials> （See the following table）， Production of grouting materials suitable for different construction environments and operation requirements.

Main performance indexes of cement-based grouting materials

Category		I	II	III	IV
Maximum aggregate size/mm		≤4.75			>4.75,and≤25
Truncated cone fluidity/mm	Initial value	---	≥340	≥290	≥650*
	30min	---	≥310	≥260	≥550*
Flow cone fluidity/mm	Initial value	≤35	---	---	---
	30min	≤50	---	---	---
Vertical expansion rate/%	3h				0.1～3.5
	Difference of expansion value between 24h and 3h				0.02～0.50
Compressive strength/Mpa	1d	≥15	≥20		
	3d	≥30	≥40		
	28d	≥50	≥60		
Chloride ion content/%		< 0.1			
Bleeding rate/%		0			

Note:* Indicates the value of slump expansion.

■Class I,Grouting material formula (kg/t)

P.042.5 Ordinary Portland cement/kg	Stone powder（More than 200 meshes）/kg	HQS-A huaqiansu/kg	Recommended water consumption/kg
500	500	20～25	150～200

■Class II,Grouting material formula (kg/t)

P.042.5 Ordinary Portland cement /kg	80-150 mesh river sand /kg	40-70 mesh river sand /kg	20-40 mesh river sand /kg	HQS-A huaqiansu /kg	Recommended water consumption/kg
400	100	200	300	18～20	130～150

■Class III,Grouting material formula (kg/t)

P.042.5 Ordinary Portland cement /kg	10-20 mesh river sand /kg	20-40 mesh river sand /kg	40-70 mesh river sand /kg	HQS-A huaqiansu /kg	Recommended water consumption/kg
400	200	200	200	12～16	130～150

■Class IV,Grouting material formula (kg/t)

P.042.5 Ordinary Portland cement /kg	Φ0.16～4.75mm mixed graded sand /kg	Φ5～25mm gravel /kg	HQS-A huaqiansu /kg	Recommended water consumption/kg
400	600	325	12～14	130～150

■Strength grade ≥C80,Special grouting material formula for wind turbine foundation of wind farm (kg/t)

P.042.5 Ordinary Portland cement /kg	80-150 mesh quartz sand /kg	40-70 mesh quartz sand /kg	20-40 mesh quartz sand /kg	HQS-A huaqiansu /kg	Recommended water consumption/kg
475	100	325	100	20～25	130～150

Special instructions:

According to JGJ355-2015<Technical Specification for Application of Steel Sleeve Grouting Connection>,JGJ1-2014<Technical Specification for Fabricated Concrete Structures>,JG/T408-2013<Sleeve Grouting Materials for Reinforcement Connection> and JG/T398-2012<Grouting Sleeve for Reinforcement Connection>,The formula of special grouting material for wind turbine foundation

of wind farm with strength grade ≥ 80 can also be used as the production formula of special sleeve grouting material for fabricated structure.

■ **Strength grade ≥ C110,Special grouting material formula for wind turbine foundation of wind farm** (kg/t)

P.042.5 Ordinary Portland cement /kg	P.052.5 Ordinary Portland cement /kg	80-150 mesh quartz sand/kg	40-70 mesh quartz sand/kg	20-40 mesh quartz sand/kg	HQS-A huaqiansu /kg	Recommended water consumption /kg
---	500	100	300	100	25～30	130～150
600	---	50kg	250kg	100kg	25～30	130～150

Wear-resistant and fire-resistant castable formula technology

According to the current national standard GB/T23294-2009<Wear-resistant and Refractory Materials>（See the following table），Production of wear-resistant refractory castables suitable for different construction environments and operation requirements.

Physical and chemical indexes of wear-resistant refractory castables

Project	Index						
	Aluminosilicate				Siliceous carbide		Zirconium chrome corundum
	ARC-1	ARC-2	ARC-3	ARC-4	ARC-5	ARC-6	ARC-7
W(Al_2O_3)/% ≥	60(SiO_2)	60	65	70	---	---	75
W(SiC)/% ≥	55(fused	---	---	---	40	80	3（Cr_2O_3）

		quartz)						2 (ZrO_2)
bulk density/ (g/cm^3) ≥	110℃×24h, after drying	1.90	2.40	2.60	2.80	2.50	2.60	2.85
Normal temperature compressive strength /Mpa ≥	110℃×24h, after drying	45	55	60	65	70	75	75
	1000℃×3h, after burning	60	80	90	100	100	110	110
Bending strength at normal temperature /Mpa ≥	110℃×24h after drying	6	7	8	9	9	9	9
	1000℃×3h, after burning	8	9	11	13	13	14	13
Heating permanent linear change rate/%	1000℃×3h, after burning	-0.3～ +0.2	-0.3～ +0.3	-0.3～ +0.3	-0.3～ +0.3	-0.3～ +0.2	-0.3~ +0.2	-0.3～ +0.3
Thermal shock resistance/second (1000℃, water-cooling)	1000℃×3h, after burning	30	20	20	25	30	35	25
Normal temperature wear resistance /cm^3 ≤	1000℃×3h, after burning	10.0	9.0	8.0	7.0	6.0	5.0	6.0
Initial setting time/min		45						
Final setting time/min		240						
Thermal conductivity		0.6～0.9	1.2～	1.3～	1.4～	3～6	7～10	2～3

(Reference value at 1000 ℃) /[W/(m·K)]		1.6	1.7	1.8			
Recommended maximum operating temperature/℃	1200	1400	1450	1500	1450	1650	1650

Note:* Indicates the value of slump expansion.

■Self-flow wear-resistant refractory castable formula (kg/t)

P.042.5 Ordinary Portland cement /kg	40-70 mesh quartz sand/kg	20-40 mesh quartz sand/kg	10-20 mesh quartz sand/kg	HQS-A huaqiansu /kg	Recommended water consumption/kg
400	200	200	200	13～15	130～150

Note:

（1）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（2）Maximum fire resistance temperature≤1200℃.

■Strength grade C50, Steel fiber wear-resistant refractory castable formula (kg/t)

P.042.5 Ordinary Portland cement/kg	40-70 mesh quartz sand /kg	20-40 mesh quartz sand /kg	110-20 mesh quartz sand /kg	Φ0.41～19mm steel fiber/kg	HQS-A huaqiansu /kg	Recommended water consumption /kg
400	150	200	200	50	13～15	130～150

Note:

（1）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（2）Maximum fire resistance temperature≤1200℃.

（3）The length-diameter ratio of steel fiber should be controlled between 60 and 100,too thick,short,hard and brittle,easily broken during mixing,It will also reduce the reinforcement effect;too long and thin,It is easy to agglomerate when stirring.Generally, the technical indicators of steel fiber shall meet the requirements of the following table.

Technical index of steel fiber for cement concrete reinforcement

material name	relative density	diameter /mm	length /mm	softening point /melting point	elastic modulus/Mpa	tensile strength/Mpa	ultimate deformation /%	poisson's ratio
mild steel fiber	7.80	0.15～0.5	20～50	500/1400	0.20	400～1200	0.4～1.0	0.30～0.33
stainless steel fiber	7.80	0.15～0.5	20～50	500/1400	0.20	500～1600	0.4-1.0	---

■Strength grade C40, Iron filings wear-resistant refractory castable formula (kg/t)

P.042.5 Ordinary Portland cement /kg	40-70 mesh quartz sand /kg	iron filings /kg	HQS-A huaqiansu /kg	Recommended water consumption /kg
400	200	400	15～20	130～150

Note:

（1）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（2）Maximum fire resistance temperature≤1200℃.

（3）Density≥4000kg/m^3.

■Strength grade C50, Iron filings wear-resistant refractory castable formula (kg/t)

P.042.5 Ordinary Portland cement/kg	40-70 mesh quartz sand/kg	iron filings/kg	HQS-A huaqiansu/kg	Recommended water consumption/kg
350	150	500	15～18	130～150

Note:

（1）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（2）Maximum fire resistance temperature≤1200℃.

（3）Density≥4000kg/m^3.

■Class I,High alumina refractory castable formula (kg/t)

CA-60/70 high alumina cement /kg	150 mesh bauxite/ kg	200-325 mesh high aluminum fine powder/kg	400 mesh aluminum oxide powder /kg	Silica fume /kg	10-20 mesh quartz sand /kg	20-40 mesh quartz sand /kg	HQS-A huaqiansu /kg
125	500	150	10	15	100	100	8～10

Note:

（1）Maximum fire resistance temperature≤1200℃.

（2）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（3）Bauxite: density 3.45g/cm^3,hardness 1-3, Al_2O_3 content≥48%,fire resistance≥1780℃,and Fe_2O_3 content is low.

（4）Aluminum oxide powder:artificial corundum above 1800 ℃.

（5）Silica fume:more than 99% silicon content,specific surface area 15-27m^2/g,activity index≥85%.

（6）Emery:density 3.06-3.20g/cm^3,mohs hardness 9.5,SiC content not less than 85%.

■Class II,High alumina refractory castable formula (kg/t)

CA-60/70 high alumina cement /kg	150 mesh bauxite /kg	200-325 mesh high aluminum fine powder/kg	400 mesh aluminum oxide powder/kg	Silica fume /kg	HQS-A huaqiansu /kg
125	700	150	10	15	8～10

Note:

（1）Maximum fire resistance temperature≤1750℃.

（2）Bauxite: density 3.45g/cm^3,hardness 1-3, Al_2O_3 content≥48%,fire resistance≥1780℃,and Fe_2O_3 content is low.

（3）Aluminum oxide powder:artificial corundum above 1800 ℃.

（4）Silica fume:more than 99% silicon content,specific surface area 15-27m^2/g,activity index≥85%.

（5）Emery:density 3.06-3.20g/cm^3,mohs hardness 9.5,SiC content not less than 85%.

■ Class I,Carborundum wear-resistant refractory castable formula

(kg/t)

CA-60/70 high alumina cement /kg	150 mesh bauxite /kg	200-325 mesh high aluminum fine powder/kg	400 mesh aluminum oxide powder /kg	Silica fume /kg	16-24 mesh emery /kg	20-40 mesh quartz sand /kg	HQS-A huaqiansu /kg
150	450	125	20	15	50	175	8～10

Note:

（1）Quartz sand: SiO_2 content≥99% and the minimum cannot be lower than 96%.

（2）Maximum fire resistance temperature≤1200℃.

（3）Bauxite: density 3.45g/cm^3,hardness 1-3, Al_2O_3 content≥48%,fire resistance≥1780℃,and Fe_2O_3 content is low.

（4）Aluminum oxide powder:density 3.9 ～ 4.1g/cm^3,hardness 8.8,melting point 2050℃,boiling point 2980℃.

（5）Silica fume:more than 99% silicon content,specific surface area 15-27m^2/g,activity index≥85%.

（6）Emery:density 3.06-3.20g/cm^3,mohs hardness 9.5,SiC content not less than 85%.

■ Class II,Carborundum wear-resistant refractory castable formula

(kg/t)

CA-60/70 high alumina cement /kg	1150 mesh bauxite /kg	200-325 mesh high aluminum fine powder /kg	400 mesh aluminum oxide powder /kg	Silica fume /kg	16-24 mesh emery /kg	HQS-A huaqiansu /kg
150	625	125	20	15	50	8～10

Note:

（1）Maximum fire resistance temperature≤1750℃.

（2）Bauxite: density 3.45g/cm^3,hardness 1-3, Al_2O_3 content≥48%,fire resistance≥1780℃,and Fe_2O_3 content is low.

（3）Aluminum oxide powder:density 3.9 ～ 4.1g/cm^3,hardness 8.8,melting point 2050℃,boiling point 2980℃.

（4）Silica fume:more than 99% silicon content,specific surface area 15-27m^2/g,activity index≥85%.

（5）Emery:density 3.06-3.20g/cm^3,mohs hardness 9.5,SiC content not less than 85%.

■Lightweight refractory castable formula (kg/t)

According to the current national standard GB 8078-1987<Lightweight ceramsite refractory concrete blocks for cement kiln> and the industry standard JGJ 51-2002 <Technical specification for lightweight aggregate concrete>,The production formula of ceramsite and vermiculite refractory castables is as follows:

CA-60/70 high alumina cement/kg	vermiculite powder/kg	Ceramsite /kg	HQS-A huaqiansu/kg	water-cement ratio (W/C)
595	280	125	25～30	0.90

Note:

（1）Maximum fire resistance temperature≤1000℃.

（2）Ceramsite: The particle size is between 5 and 20 mm,The density is between 300 and 500kg/m^3.

（3）Vermiculite powder meets the requirements of the following table:

density (kg/m^3)	total porosity (%)	micropore (%)	macropore (%)	conductivity (mg/kg)	water holding capacity (%)	gas-water ratio	volume expansion after adding water/ (times)
130～180	133.5	108.5	25.0	0.36	55	1: 4.34	15～25

Formulation technology of ready-mixed concrete and self-compacting concrete

According to the current national standard GB/T14902-2012<Ready-mixed Concrete>and the industrial standard JGJ/T 283-2012<Technical Specification for Application of Self-compacting Concrete>,The commonly used quick reference table of concrete formula with different strength grades is as follows:

■ **Strength grade C15,Quick reference table of concrete mix proportion** (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	16-31.5	10-30	/	37	175	260	/	720	1235	3.50
f-2	20-40	10-30	/	36	170	260	/	715	1275	3.50
f-3	16-31.5	160-180	/	43	190	320	/	825	1090	9.60
f-4	20-40	160-180	/	43	190	315	/	820	1090	9.45
f-5	20-40	30-50	/	36	180	270	/	715	1255	4.05
f-6	20-40	55-70	/	35	190	280	/	690	1270	4.25
f-7	5-16	10-30	/	37	195	310	/	710	1210	4.65
f-8	5-31.5	180-200	/	42	195	320	/	805	1110	9.60
f-9	5-40	180-200	/	41	195	315	/	790	1130	9.45

■ **Strength grade C20,Quick reference table of concrete mix**

proportion (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio/ %	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	5-31.5	180-200	/	41	200	355	/	770	1110	10.65
f-2	5-40	180-200	/	40	195	350	/	760	1125	10.50
f-3	20-40	30-50	/	34	180	315	/	660	1270	4.73
f-4	20-40	55-70	/	34	190	335	/	655	1250	5.03
f-5	20-40	55-70	/	36	160	280	/	710	1270	4.20
f-6	20-40	75-90	/	35	200	340	/	665	1225	5.16
f-7	5-16	10-30	/	36	200	335	/	680	1215	5.00
f-8	5-16	35-55	/	37	205	340	/	695	1190	5.10
f-9	16-31.5	55-70	/	34	195	335	/	650	1250	5.14
f-10	16-31.5	55-70	/	36	165	285	/	705	1260	4.28
f-11	16-31.5	75-90	/	35	205	345	/	665	1255	5.18
f-12	20-40	10-30	/	35	170	290	/	690	1280	4.35
f-13	20-40	120-140	/	42	180	330	/	810	1110	9.90
f-14	20-40	160-180	/	42	195	355	/	790	1090	10.65
f-15	16-31.5	160-180	/	42	190	355	/	790	1090	10.65
f-16	16-31.5	10-30	/	35	175	305	/	685	1265	4.58
f-17	16-31.5	30-50	/	35	185	315	/	675	1255	4.73

■ **Strength grade C25,Quick reference table of concrete mix proportion** (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	16-31.5	10-30	/	34	170	335	/	660	1270	5.03
f-2	16-31.5	160-180	/	41	190	390	/	755	1090	11.70
f-3	16-31.5	30-50	/	34	185	360	/	645	1240	5.55
f-4	16-31.5	55-70	/	35	200	375	/	635	1215	5.65
f-5	20-40	75-90	/	34	200	380	/	625	1235	5.75
f-6	16-31.5	180-200	/	40	200	390	/	740	1105	11.70
f-7	50-40	180-200	/	39	195	385	/	625	1125	11.55
f-8	16-31.5	55-70	/	35	165	310	/	680	1270	6.20
f-9	16-31.5	75-90	/	34	205	385	/	635	1225	7.70
f-10	20-40	10-30	/	34	175	340	/	650	1270	5.10
f-11	20-40	120-140	/	41	180	350	/	775	1120	8.95
f-12	20-40	160-180	/	41	195	385	/	760	1090	11.55
f-13	20-40	55-70	/	34	160	310	/	665	1285	6.00
f-14	20-40	35-50	P6	40	154	/	298	762	1144	8.95
f-15	5-31.5	55-70	P6	39	156	/	298	741	1161	8.95
f-16	5-31.5	35-50	P6	40	145	292	/	768	1152	8.76

f-17	5-31.5	55-70	P6	39	150	303	/	743	1161	9.09
f-18	5-31.5	35-50	P6	39	142	314	/	752	1176	9.42

■ Strength grade C30,Quick reference table of concrete mix proportion (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	Water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	5-40	160-180	/	44	170	340	/	815	1055	10.20
f-2	5-40	180-200	/	38	200	430	/	685	1120	12.90
f-3	5-40	180-200	/	42	180	345	/	800	1110	10.35
f-4	5-40	35-50	/	34	175	350	/	645	1260	5.25
f-5	5-40	35-50	/	36	145	290	/	715	1270	4.35
f-6	5-40	55-70	/	34	185	365	/	635	1240	5.85
f-7	5-31.5	180-200	/	39	200	440	/	700	1100	13.20
f-8	5-31.5	180-200	/	40	180	340	/	765	1140	10.20
f-9	5-31.5	35-50	/	34	185	350	/	635	1240	5.25
f-10	5-31.5	55-70	/	34	192	370	/	625	1220	6.35
f-11	5-31.5	55-70	/	35	150	290	/	690	1275	5.25
f-12	5-40	120-140	/	40	165	325	/	785	1175	9.75
f-13	20-40	55-70	/	35	190	370	/	660	1220	7.40
f-14	20-40	55-70	/	36	152	295	/	715	1270	5.85
f-15	20-40	75-90	/	33	205	445	/	590	1210	8.90

f-16	5-16	10-30	/	35	200	415	/	590	1210	6.25
f-17	5-16	35-55	/	35	205	425	/	625	1165	6.38
f-18	5-16	160-180	/	40	175	335	/	770	1155	10.05
f-19	20-40	160-180	/	39	180	400	/	730	1140	12.00
f-20	20-40	35-50	/	33	180	390	/	615	1245	5.85
f-21	20-40	35-50	/	35	180	350	/	670	1240	5.25
f-22	20-40	35-50	/	36	150	290	/	720	1280	4.35
f-23	20-40	55-70	/	33	195	425	/	605	1215	6.85
f-24	20-40	55-70	/	34	175	340	/	660	1265	5.45
f-25	16-31.5	55-70	/	36	195	370	/	660	1285	6.29
f-26	16-31.5	55-70	/	36	150	295	/	705	1260	5.02
f-27	16-31.5	75-90	/	33	210	430	/	595	1195	8.55
f-28	20-40	120-140	/	40	185	385	/	750	1115	11.55
f-29	20-40	120-140	/	40	165	330	/	780	1175	9.90
f-30	20-40	160-180	/	40	195	430	/	715	1080	12.90
f-31	16-31.5	160-180	/	40	180	335	/	760	1150	10.05
f-32	16-31.5	180-200	/	39	180	400	/	720	1130	12.00
f-33	16-31.5	35-50	/	33	190	400	/	610	1235	6.50

f-34	16-31.5	35-50	/	34	185	355	/	640	1235	5.68
f-35	16-31.5	35-50	/	35	150	290	/	596	1285	5.25
f-36	16-31.5	55-70	/	36	170	340	/	670	1250	6.10
f-37	16-31.5	10-30	/	33	175	375	/	620	1255	5.65
f-38	16-31.5	120-140	/	40	170	385	/	760	1135	11.55
f-39	16-31.5	160-180	/	40	190	430	/	720	1085	12.90
f-40	5-31.5	35-50	P8	40	153	/	296	771	1156	8.88
f-41	5-31.5	55-70	P8	38	147	325	/	727	1186	9.75
f-42	5-31.5	35-50	P8	35	140	331	/	676	1255	9.93

■ **Strength grade C35,Quick reference table of concrete mix proportion** (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	16-31.5	35-50	/	35	145	375	/	660	1240	6.35
f-2	16-31.5	35-50	/	35	150	335	/	680	1265	5.65
f-3	16-31.5	35-50	/	34	195	410	/	620	1200	6.60
f-4	5-31.5	35-50	P8	35	140	368	/	668	1242	11.04
f-5	5-31.5	35-50	P8	39	152	/	304	717	1121	9.12

f-6	5-31.5	55-70	P8	36	144	340	/	690	1226	10.20

■ Strength grade C40,Quick reference table of concrete mix proportion (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	16-31.5	35-50	/	34	150	/	375	650	1250	6.00
f-2	16-31.5	55-70	/	34	145	425	/	640	1225	7.25
f-3	5-31.5	35-50	/	34	155	420	/	645	1225	7.15
f-4	5-31.5	55-70	P10	36	143	368	/	683	1214	11.55
f-5	5-31.5	35-50	/	35	145	/	370	660	1245	9.25

■ Strength grade C45,Quick reference table of concrete mix proportion (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	5-31.5	35-50	/	33	160	460	/	600	1220	7.40
f-2	5-31.5	35-50	/	34	150	/	390	645	1260	6.65

■ Strength grade C50,Quick reference table of concrete mix proportion (kg/m^3)

formula	gravel size /mm	Slump /mm	impermeability grade	sand ratio /%	water /kg	P.C32.5 cement /kg	P.042.5 cement /kg	medium sand /kg	Gravel /kg	HQS-A huaqiansu /kg
f-1	16-31.5	35-50	/	32	150	500	/	570	1210	9.00

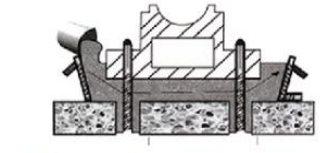
f-2	16-31.5	55-70	/	35	148	/	445	650	1200	8.00
f-3	5-31.5	55-70	/	34	150	/	445	630	1220	8.00

Equipment foundation grouting construction technology

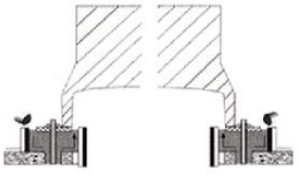
■Selection of grouting materials

grout layer thickness	It is recommended to give priority to grouting materials
When the thickness of the grouting layer is greater than 30mm and less than 150mm.	Class III grouting material
When the thickness of the grouting layer is greater than 10mm and less than 30mm.	Class II grouting material
When the thickness of grouting layer is greater than 150mm.	Class IV grouting material
When the thickness of grouting layer is less than 10mm.	Class I grouting material

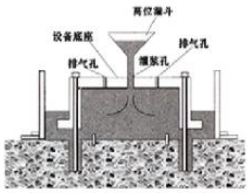
■Grouting methods



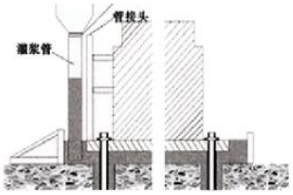
self-gravitation method grouting



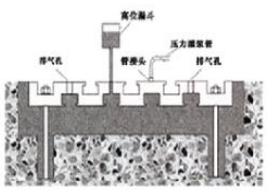
self-gravitation method grouting



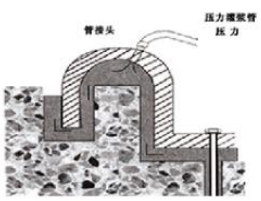
high-place funnel method grouting



high-place funnel method grouting



pressure grouting



pressure grouting

■Foundation treatment

Before grouting, the equipment base plate and foundation concrete surface in contact with the grouting material must be cleaned.There shall be no loose gravel, laitance, floating ash, oil stain, wax, etc.

24h before grouting,the foundation concrete surface shall be fully wetted.

1h before grouting,water should be removed.

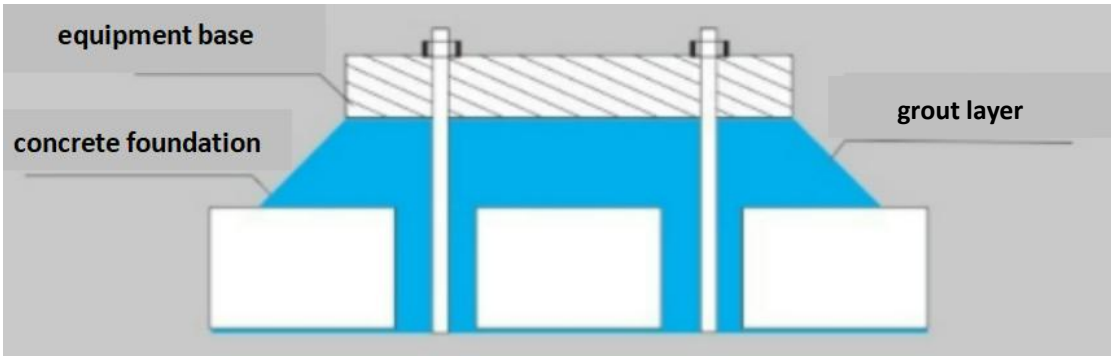
■Grouting

When the track foundation or grouting distance is long, the method of sectional grouting shall be adopted.

Pour the prepared grouting material continuously from one side until it overflows from the other side.It is forbidden to grout from opposite sides at the same time.

It is forbidden to vibrate during grouting,The grouting booster (see the figure below) can be used to push the grouting material along the bottom of the flow direction of the grouting material slurry,It is forbidden to push from the middle and upper part of the grouting layer.

End of grouting,45° bevel shall be cut outward along the edge of the base plate after 3~6h. (See the figure below)



■Formwork removal and curing

End of grouting,the exposed part shall be sprayed with curing agent in time,加 cover the straw bag and keep it wet,the curing time shall not be less than 7d.

When plastic film is used for covering, it shall be tightly covered to keep condensation water in the film.

After formwork removal,when the difference between the surface temperature of the grouting material and the ambient temperature is greater than 20 ℃, thermal insulation materials shall be used to cover the curing.

The curing temperature is generally not higher than 65 ℃,the relationship between formwork removal and curing time and ambient temperature is as follows:

daily minimum temperature/℃	formwork removal time/h	curing time/d
-10～0	96	14
0～5	72	10
5～15	48	7
≥15	24	7

■Winter construction

When the average temperature of the day is lower than 5 ℃, the construction shall be carried out in winter.The construction operation shall meet the following requirements:

(1) Before grouting,Measures shall be taken to preheat the foundation surface to keep its temperature above 10 ℃,and remove the accumulated water.

(2) Use warm water not higher than 65 ℃ to mix the grouting material,and the temperature of grouting material shall be above 10 ℃.

(3) Before freezing,The compressive strength of grouting material shall not be less than 5Mpa.

(4) The performance of grouting materials used for winter construction shall also comply with the following table:

temperature (℃)	compressive strength ratio (%)		
	R_{-7}	R_{-7+28}	R_{-7+56}
-5	≥20	≥80	≥90
-10	≥12		

■Construction under high temperature environment

When the temperature of the construction site is greater than 35 ℃, it should be carried out according to the high temperature environment.The construction operation shall meet the following requirements:

(1) 2h before grouting,The construction site shall be protected from direct sunlight or other heat radiation.

(2) Take cooling measures,the temperature of concrete foundation and equipment base plate in contact with grouting material shall not be higher than 35 ℃.

(3) The temperature of grouting material shall not be higher than 30 ℃.

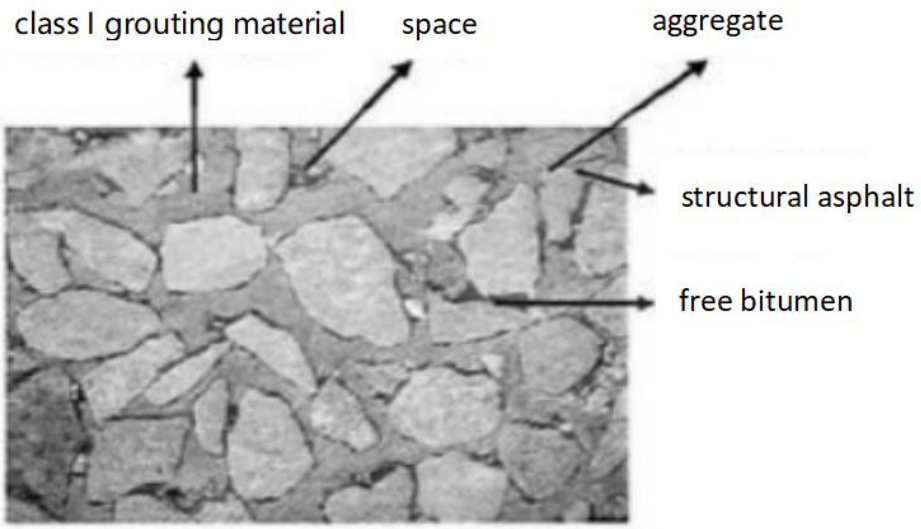
(4) End of grouting,moisturizing and curing measures shall be taken in time.

Construction technology of pre-filled aggregate concrete

■Structure

Class I grouting material is preferred.If necessary, HQS-A huaqiansu in the formula of Class I grouting material can be replaced with HQS-Super100 huaqiansu,the addition of HQS-Super100 huaqiansu is 2% of the weight of cement.

First, fill the coarse aggregate of the stone into the formwork.Then, Class I grouting material is poured through the embedded material transmission pipeline and make sure to fill all the gaps,make the Class I grouting material and aggregate aggregate aggregate together to form an integrated high-strength concrete whole composed of "Class I grouting material+stone". (see the figure below)



■Pre-filled coarse aggregate

The coarse aggregate shall be compacted and pre-filled into the preset formwork as required.

According to the current national standard GB/T14685-2001<Pebble and

Gravel for Construction>and the current industrial standard JGJ53<Quality Standard and Test Method for Gravel and Gravel for Ordinary Concrete>,aggregate with particle size greater than 5mm is coarse aggregate,Pebble and gravel are generally divided into Class I, Class II and Class III.Class I is used for concrete with strength grade greater than C60,Class II concrete for C30-C60,Class III is used for concrete less than C30.The compressive strength of coarse aggregate shall be greater than 1.5 times of the strength of prepared concrete and not less than 45MPa.If conditions permit, the aggregate with larger particle size shall be selected as far as possible.

■Lay conduit

Multi-section steel pipes with a diameter of 200 mm~300 mm are used for the material conveying conduit,The connection of pipe joint is sealed and firm.Before grouting,trial assembly and water tightness test shall be conducted.

The level layout distance of the feeding conduit shall not be more than 3m and the distance from the ends of both sides of the formwork shall not be more than 1.5m,The distance from the lower end of the feeding duct to the bottom is 300mm-500mm.A water trap shall be placed in the feed conduit.

■Grouting

Use the pressure grouting pump to conduct uniform and continuous grouting,Even if there is an interval between operations, the interval time should not exceed 30min.

In the formwork, the rising speed of the grout level should not be less than 3

m/h and should not be greater than 5 m/h.

During grouting,The feeding duct shall be buried in the grout poured first, and the depth shall be controlled between 2m and 4m, and the height difference of grouting material between two adjacent ducts shall be less than 0.5m.

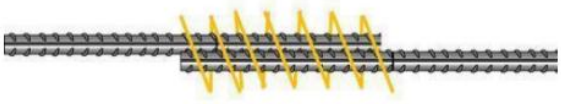
■Grouting pressure

The grouting pressure is related to the consistency of Class I grouting slurry, the average particle size of pre-filled aggregate and the required diffusion radius.Generally,If the average particle size of the pre-filled aggregate is within 150 mm and the diffusion radius is within 1.5 m, when the water depth is zero, the slurry discharge pressure at the pipe bottom is 50~150 kpa.In case of water tank surface, the slurry discharge pressure at the pipe bottom shall be added with the water pressure caused by the corresponding water depth.

Grouting technology of prefabricated structural sleeve

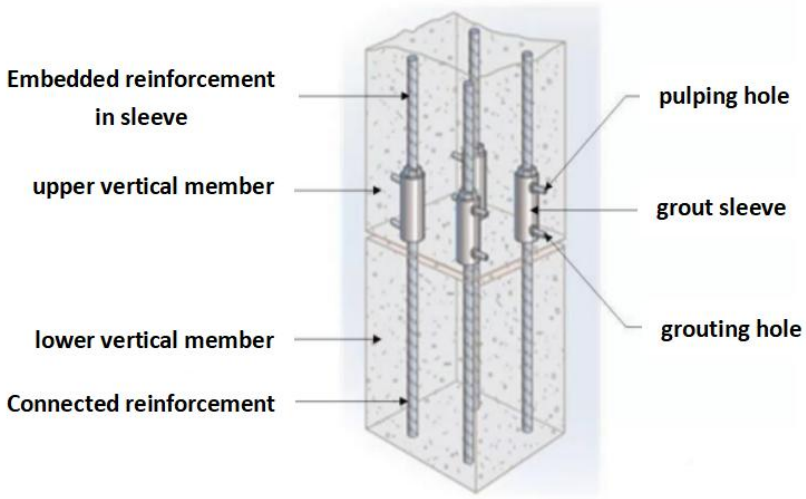
■Sleeve grouting connection technology

After inserting the reinforcement in the metal sleeve, the grouting material shall be poured again, as shown in the figure below.

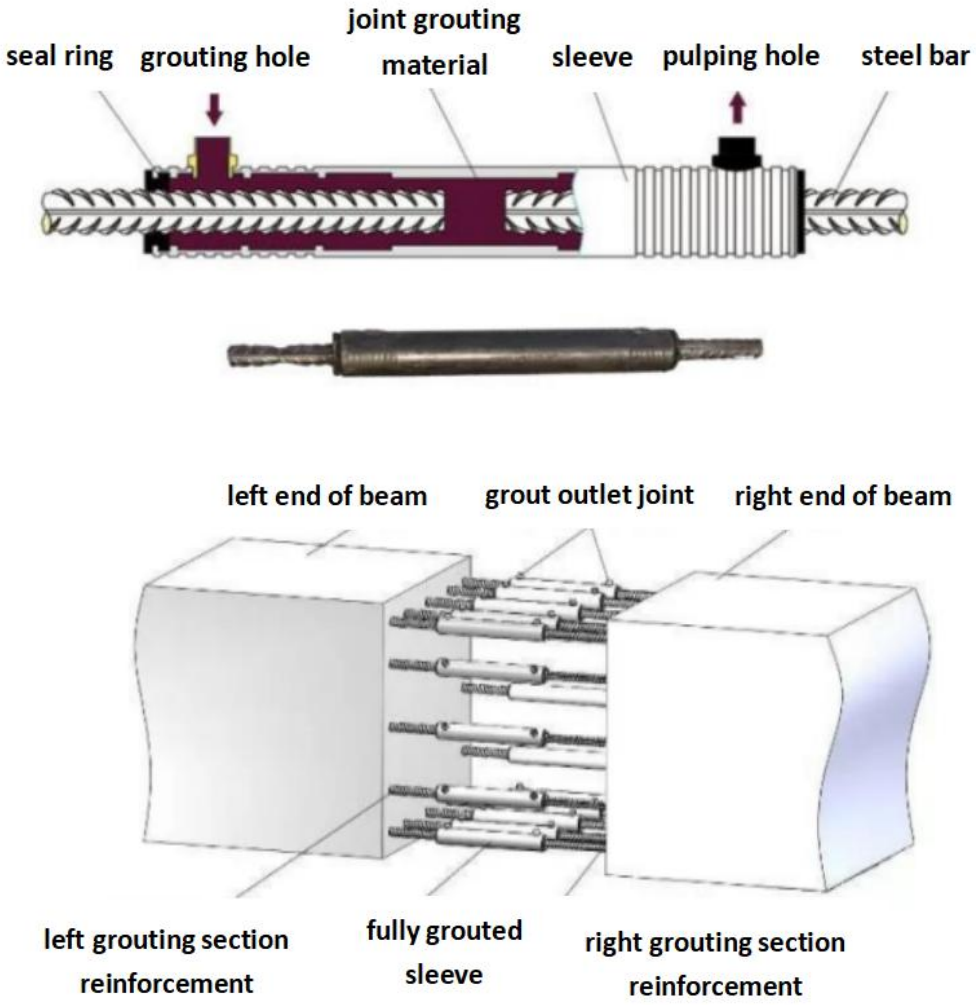


spiral stirrup mortar anchor lap

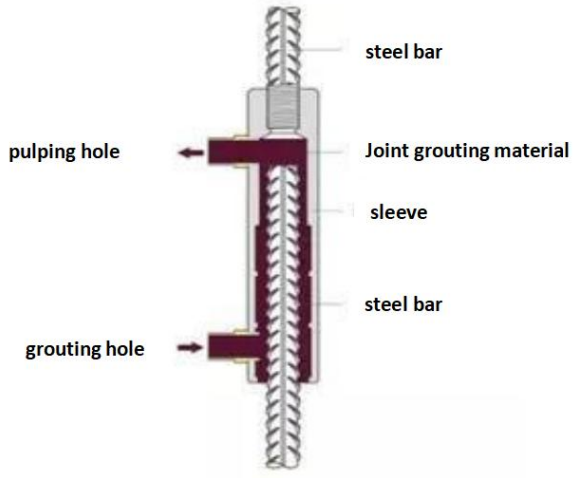
corrugated pipe slurry anchor lap

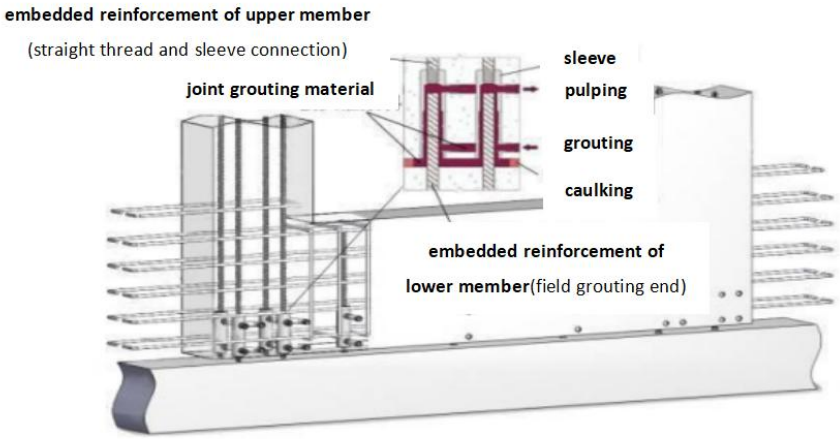


（1） Full sleeve grouting connection technology:It is mainly used for the connection of level reinforcement. The reinforcement is inserted at both ends of the sleeve and grouted to form an integral connection.See the figure below:

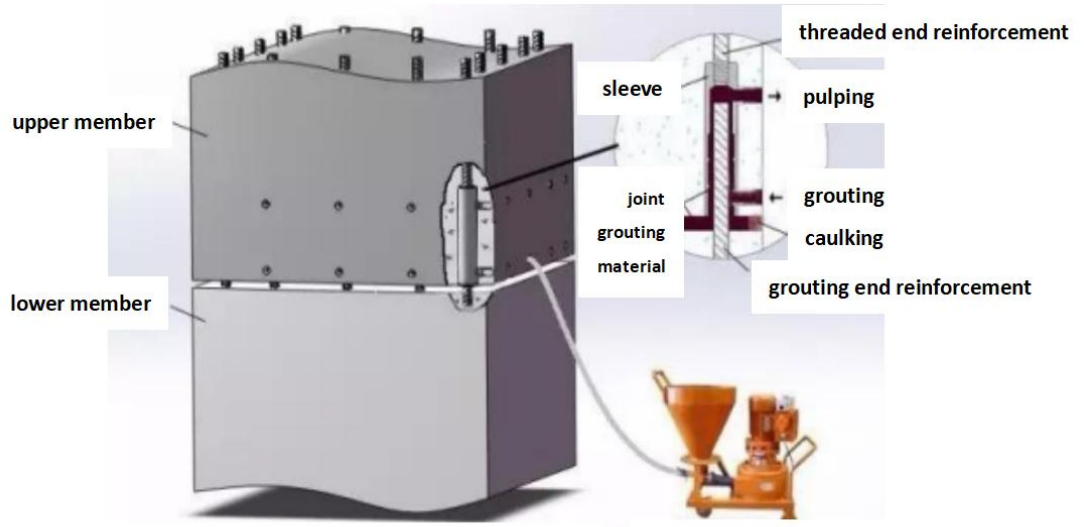


（2） Semi-sleeve grouting connection technology:It is mainly used for the connection of longitudinal reinforcement,One end of the sleeve is connected with the connecting reinforcement by screw fastening, and the other end is grouted with the dowel bar.See the figure below:





（3） Grout anchor connection technology:It is mainly used for the connection of the vertically distributed reinforcement (not the main load-bearing reinforcement) of the shear wall.Holes are reserved in the prefabricated members, and the stress transmission between the reinforcing bars is realized through the binding mortar anchor lap connection or metal bellows lap connection inside and outside the holes.



Schematic diagram of frame column connection

electric grouting pump

■Sleeve grouting construction

(1) Check whether the grouting hole and air outlet of the sleeve are blocked. If there is any blockage, dredge it first.

(2) Connect the grouting pipe and prepare the pipe joint.

(3) Grout mixing:Use a low-speed mixer to mix for 3~5min according to the water consumption recommended by the manufacturer.

Adopt high-speed mixing equipment, such as electric hand drill,there are many bubbles,it must be left for about 2 minutes,must wait for the bubble to burst.

Manual mixing is adopted,at the beginning, the viscosity of grouting material is relatively high,the mixing time must be increased,do not add more water at this time。

(4) Grouting:Adopt manual or mechanical equipment,Pour the grout from one end until the grout is discharged from the other end,close the grouting port and exhaust port.End of grouting,do not vibrate or shake the grouting position within 24 hours.

Construction technology of wear-resistant and fire-resistant castables

■Construction personnel

All construction personnel must receive three-level safety education, and have more than one year of experience in the construction of environmental wear-resistant refractory castables.

■Machines and tools and necessary items

serial number	name	quantity	parameter
1	forced mixer	2～3	23-26 revolutions per minute
2	vibrating spear	2～3	1 spare
3	release oil	enough	grease, oil
4	scales	2	
5	wooden trowel	2～4	
6	mortar barrel	2～4	
7	shovel	6～8	
8	level ruler	1	

■Mixing

The quality of mixing water shall meet the drinking water standard,PH value=7.0-7.5.It is better to conduct small sample test before construction to determine the water source.

Start the forced mixer,pour the castable into the machine and add water and stir for 3-5 minutes.Adjust the water volume according to the temperature, humidity and liquidity.Generally,It is better to control within 15 minutes from adding water and mixing to the completion of construction.Castables that lose

fluidity or begin to set shall not be used.

■Templates installing

The formwork must be installed firmly and accurately,It can bear certain supporting force to ensure no deformation.

The thickness of non-water-absorbing wood formwork shall meet the requirements of different construction parts,the contact part between the formwork and the pouring material shall be coated with release agent or pasted with release paper.

The surface of steel formwork must be smooth,the connection joints between each template must be tight and free of gaps,the plane shall be kept flat as a whole to ensure no slurry and liquid leakage.

■Pouring

The construction temperature shall be controlled between 5 and 35 ℃,larger furnace shall be constructed continuously without stopping halfway.In case of special circumstances where the construction cannot be continuous, measures shall be taken to delay the solidification of materials,the retarding measures shall be confirmed by the material manufacturer.

During layered construction, 2-3 mixers shall be used to mix materials to ensure the continuous construction needs, so as to make the natural connection between layers and avoid layering.

■Vibrating

Vibrate immediately after pouring,it is not allowed to miss vibration or vibrate

and re-vibrate at the same position for a long time to avoid segregation and holes in the castables.

■curing

End of pouring,Curing shall be carried out in time after initial setting.The curing temperature shall be controlled between 10 and 35 ℃,When the slurry surface is dry and the strength reaches more than 70%, the formwork can be removed.

■drying

According to the thickness of the castable lining and the climatic conditions on the site, sufficient baking time must be provided to ensure water removal and avoid cracking.

Packaging, storage and transportation

The packaging specification of this product is 25kg/bag, or 2.5kg/bag.

This product should be stored in a dry and ventilated environment to avoid rain, water, moisture, and sun exposure. The unopened shelf life is 12 months.

This product is nonflammable, non-explosive, non-toxic and tasteless, and does not contain heavy metals, halogenated hydrocarbons, benzene series, formaldehyde, VOC and other harmful substances. It can be stored and transported as general goods.

Statement on data and other recorded contents

■The data recorded in this document are based on typical experimental values, so there is no guarantee for the recorded content.

■Before use, please confirm the detailed use method and precautions according to this information and product safety data.

■When using, your company must carry out a prior test to confirm whether it meets the use purpose and safety.

■The contents of this document are subject to change without notice.

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