

MasterRoc FLC 100

Admixture, in powder form, based on inorganic components for use in the production of grouts for the protection of post-tensioned cables in prestressed concrete, or of grouting operations (anchoring cables, bolts, nails, etc.) into grounds or rocks. Chloride-free.

DESCRIPTION AND WHERE TO USE

MasterRoc FLC 100 is a product in powder to be added at the rate of about 6% by weight of cement to produce a flowable, pumpable, no-shrink, no-segregating, impermeable grout providing high strength and high bond to steel.

The most important feature of MasterRoc FLC 100 imparts to filling grout is the protection of cables against corrosion from aggressive agents and against stress corrosion.

The inadequate protection against corrosion offered by normal grouts is due to:

a) high capillary microporosity due to high water/cement ratio. Using MasterRoc FLC 100 the water/cement ratio is about 0.3;

b) high macroporosity caused by bleeding of water, collecting under strands and in the upper part of the sheath (Fig. 1); when water from bleeding evaporates and is reabsorbed by the cement paste, big cavities thus provide easy access for corroding substances. An Italian standard (law n° 1086) prescribes that the volume of water from bleeding must not exceed 2%, while European recommendations on pre-stressed concrete (FIP) indicate an even lower value: 0.5%. With MasterRoc FLC 100 the volume of water caused by bleeding is considerably lower: it ranges from zero to a maximum of 0.2% depending upon the type of cement used;

Table 1 - Examples of properties of cement pastes containing 6% of MasterRoc FLC 100

Type of cement	H ₂ O % on cem. weight + MasterRoc FLC 100	Flow Cone (1) (seconds)			Bleed water (2) (% by volume)	Water retention (3) (%)	Expansion at 2 days (4) (µm/m)	Setting times at 30°C (hrs: mins)		Specific gravity (g/cm ³)
		0'	30'	1 ^h				Start	End	
CEM I 52,5	34,4	23	33,0	38	0,13	95,6	450	4:15	4:45	2,030
CEM II 42,5 (A)	33,6	23	25,5	34	0,03	97,2	700	4:35	5:05	2,020
CEM II 42,5 (B)	29,6	25	27,0	30	0,00	95,4	500	3:25	3:45	2,045
CEM II 42,5 (C)	30,4	25	31,0	33	0,10	96,0	500	4:15	4:55	2,050
CEM II 32,5 (A)	28,8	22	23,0	24	0,10	97,4	750	4:00	4:33	2,080
CEM II 32,5 (B)	29,6	23	25,0	28	0,12	94,0	600	3:47	4:15	2,075
CEM III 32,5	32,4	24	25,0	26	0,15	93,7	600	5:00	5:40	2,010
CEM IV 32,5	32,0	22	27,0	30	0,15	92,0	500	5:05	5:55	2,070

(1) Flow-Cone Test (conforming to CRD-C-79) after varying times of continuous mixing.

(2) Test conforming to ASTM C 232.

(3) Test conforming to ASTM C 91; the value was taken after 5 min.

(4) Test conforming to ASTM C 878. No Length changes were observed at later times.

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Table 2 - Examples of strength and bond to steel of cement pastes containing 6% of MasterRoc FLC 100

Type of cement	Compressive Strengths (MPa)						Bond to steel (1) (MPa)	
	1 day		7 days		28 days		7 days	28 days
	C	F	C	F	C	F		
CEM I 52,5	32,3	4,2	52,8	5,0	61,9	5,2	18,0	18,5
CEM II 42,5 (A)	27,4	3,8	52,4	4,7	67,1	5,0	18,4	18,8
CEM II 42,5 (B)	23,1	4,0	53,4	6,5	63,2	7,0	20,0	20,9
CEM II 42,5 (C)	23,4	4,3	42,9	4,7	55,3	5,2	15,8	17,8
CEM II 32,5 (A)	22,2	4,2	37,2	5,0	53,1	5,5	17,0	18,8
CEM II 32,5 (B)	20,5	3,4	41,2	5,1	56,1	5,6	17,0	17,8
CEM III 32,5	16,8	3,2	42,8	6,0	57,0	6,3	18,3	19,0
CEM IV 32,5	16,0	3,0	41,0	5,5	58,0	6,5	16,5	17,5

(1) Pull-out test conforming to the standard prescribed by the RILEM-CEB-FIP Committee (1970).
C = Compressive strength; F = Flexural strength

c) shrinkage of cement paste and consequent cracking. With normal cement grouts final shrinkage varies from 2000 to 3000 $\mu\text{m/m}$. MasterRoc FLC 100 allows not only shrinkage to be eliminated completely, but also slight expansion to occur during setting and hardening.

The main properties of grouts containing 6% of MasterRoc FLC 100, shown in Tables 1 and 2, can be summed up as follow:

- Very high flowability (as measured by the Flow Cone Test) without bleeding or with a very low amount of it water from bleeding. The pumpability of the grout is assured for at least two hours at + 20°C.
- High mix water retention. This very important property imparts high cohesion to the very flowable mix. Under vacuum, of 600 mm Hg over 90% of the water is retained by the flowable grout. Inadequate water retention would allow water separate from solid components when the grout is forced through strands of tendons.
- Absence of shrinkage, and expansion ranging from 200 to 800 $\mu\text{m/m}$ depending upon the type of cement used. Initial setting time of more than 3 hours at + 30°C (according to law n° 1086).
- High early and ultimate strengths: depending on the type of Portland cement used strengths can range from 20 to 40 MPa at 1 day and from 50 to 70 MPa at 28 days. Slightly lower values are obtained if pozzolanic or slag cements are used.

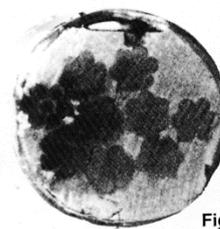


Fig. 1

Fig. 1

Section of sheath of post-tensioned cables filled with a cement paste showing bleeding water.

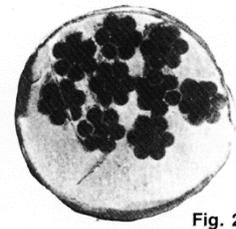


Fig. 2

Fig. 2

Section of sheath of post-tensioned cables filled with a cement paste containing MasterRoc FLC 100. No bleed water is observed.

- High bond to steel: after 7 days the value is in excess of 15 MPa.

Owing to its high flowability, a grout made with cement (94%) and MasterRoc FLC 100 (6%) assures the complete filling of sheaths, especially among the strands of cables. This ensures maximum protection of steel against corrosion caused by aggressive agents. As this high flowability is obtained with low water/cement ratio, the hardened cement paste is dense, compact, impermeable and, therefore, highly durable. On the other hand, the high cohesion of the fresh mix, together with the freedom from shrinkage, prevents the formation of big cavities which are often responsible for the penetration of aggressive agents.

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Technical Information	
Form	Grey Powder
Relative bulk density (g/ml at 20°C)	0,500 – 0,700
Bulk density (g/ml at 20°C)	2,163 - 2,183

Mixing Instructions

Introduce approx. 25 litres of water per 100 kg of cement into the mixer. Start the mixer and first add MasterRoc FLC 100 (6% by the weight of cement) and then cement.

Mix for 3 minutes until a plastic and homogeneous mixture is obtained. Add approx. 7 litres of water and mix further for 2 minutes until the grout is flowable and without lumps and the flow cone empties in approx. 20 sec.* (Fig. 3). If a high speed mixer is used (about 1500 r.p.m.) the total mixing time can be reduced from 5 to 3 minutes. The necessary mixing water by weight of cement and MasterRoc FLC 100 is approx. 34% but can range from a minimum of 30% to a maximum of 38% depending on the cement used: finely ground cement usually requires a higher amount of water. The grout thus obtained can generally be pumped for at least 2 hours, unless the cement used shows rapid or false set.

* Note

The time prescribed for discharging the grout through the flow cone varies according to standards or recommendations. In the U.S. for instance, the Corps of Engineers Standard (CRD-C - 79) prescribes a time of efflux between 10 and 30 sec.

Autostrade S.p.A. specification prescribes that the measurement of flowability has to be executed by a modified Flow Cone. The instrument must be in stainless steel and have the following shape and size: 15.5 cm base diameter, height: 29.0 cm; nozzle inside diameter 1.0 cm; height: 6.0 cm; upper mortar level: 1 cm from top. Grout flowability is indicated by the total time of efflux divided by two. Grout flowability is considered proper when the above time (time of efflux divided by two) ranges between 15 and 25 sec. for freshly mixed pastes and from 25 to 35 sec ' for pastes mixed and 30 minutes before (both values refer to the temperature of + 20°C).

DOSAGE AND YIELD

Approximately 68 litres of highly flowable grout are obtained by mixing 100 kg of cement, 6 kg of MasterRoc FLC 100 and 34 litres of water.

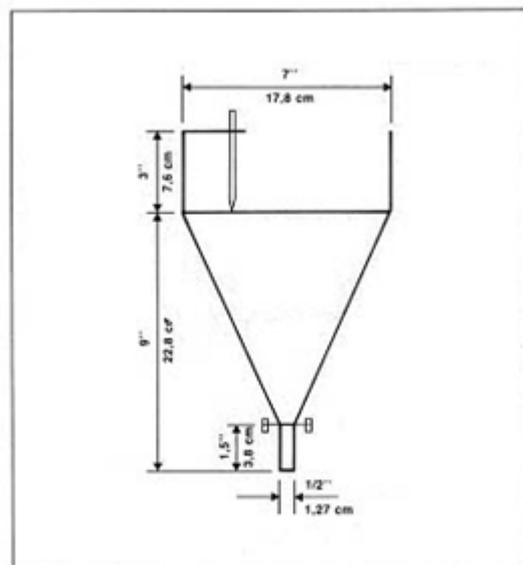


Fig. 3
Sezione del «Flow Cone».

PACKAGING AND STORAGE

MasterRoc FLC 100 is available in 15 kg bags that shall be stored in a dry and sheltered environment like cement based materials. Do not use the product if the bag has been opened for more than one month.

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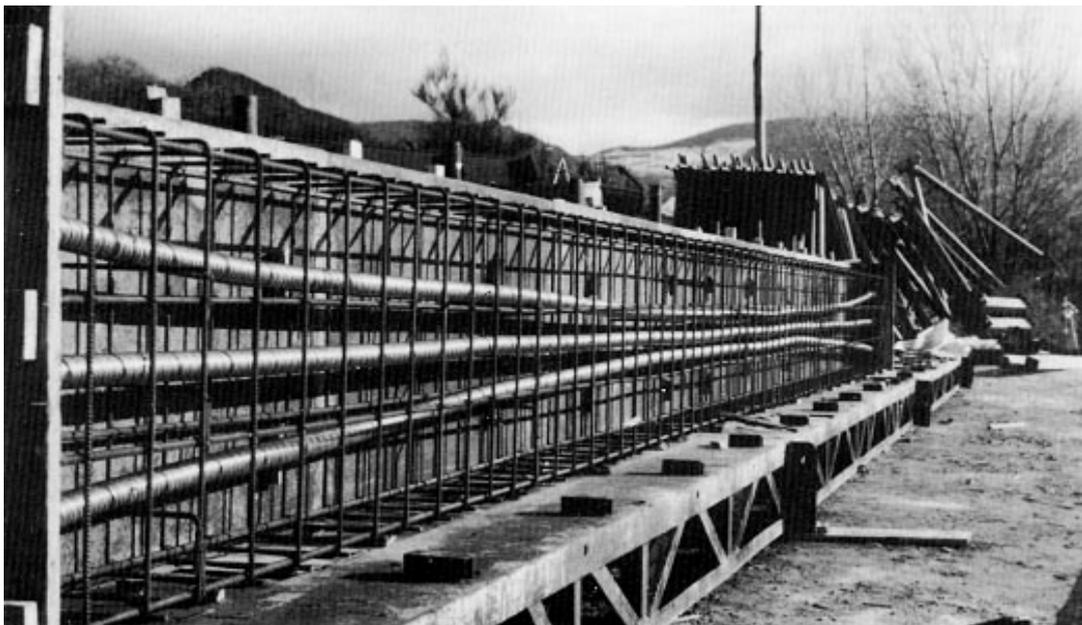
SAFETY PRECAUTIONS

The temperature of walls and spaces where the grout is to be pumped should be between +5 and +40°C for optimum results. If temperature is outside this range, consult your local BASF Construction Chemicals representative.

MasterRoc FLC 100 is a chloride-free product, which is specially important in the case of cables. However, chlorides can be introduced into a mix if brackish water or special types of cement are used. Therefore, the use of

drinkable water (generally containing less than 40 mg/l of chloride) and chloride-free cements (Chloride ions lower than 0.06% by weight of cement) is recommended.

Though all Portland, pozzolanic or slag cements may be employed, the use of Portland cement type I and, preferably, type II, is recommended in cold weather.



From 16/12/1992 BASF Construction Chemicals Italia Spa operates under the Quality System in compliance with European Standard UNI-EN ISO 9001. The environmental management system of BASF Construction Chemicals Italia Spa is certified accordingly to UNI EN ISO 14001.

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For further information, please consult your local BASF Construction Chemicals Italia Spa representative.

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Supersedes all prior issues on this product.

January 2016

