Preparing a High Strength, High Ductility Concrete

with Ultra High Molecular Weight Polyethylene

ACI Materials Journal Title 110-M37

MINIFIBERS, INC.

Steel Hook Fibers compared to Ultra High Molecular Weight (UHMW) Polyethylene

Testing Done at University of Michigan

Fiber Properties UHMWPE	
Length	12 mm
Strength (MPa)	3,000
Specific Gravity	0.97 g/cc
Melting Point	150 C

Composite Properties

	Compressive Strength (MPa)	Ultimate (MPa) Tensile Strength	Tensile Strain (%)
VHSC (Steel)	201	10.4	0.18
HSHDC v0 PE 38 micron	160	11.8	3.50
HSHDC -PE 28micron	149	13.0	2.50
HSHDC - S0.83 PE micron	156	13.9	3.10
HSHDC - S0.70 PE micron	166	14.5	3.40
HSHDC - S0.60 PE micron	160	14.4	3.30

Mix Design kg/m^3

Fresh Mix Formulae	all kg/m3	38 micron PE	28 micron PE	28 micron PE	28 micron PE	28 micron PE
Ingredient	VHSC	HSHDC v0	HSHDC -PE28	HSHDC S0.83	HSHDC -S0.70	HSHDC - S0.60
Cement	819	827	821	861	903	936
Silica Fume	320	323	321	336	352	365
Silica flour	229	232	230	241	253	262
Silica Sand	795	802	797	715	632	561
Water	172	173	172	180	189	196
HRWRA	7	13	20	19	16	15
Steel Fiber	287	-	-	-	-	-
PE Fiber	-	19	19	19	19	19

Conclusion

- UHMW PE Fiber
  - Reduces slump slightly, added HRWRA compared to steel hook fiber
  - Smaller diameter fiber, with a larger aspect ratio, gives higher ultimate tensile strength
  - UHMW PE fiber produces a composite with much higher ductility
    - Lowering sand to cement ratio brought some gains in ultimate tensile strength and compressive strength

Ultra High Molecular Weight Polyethylene Fibers are available from

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