EUCLID CHEMICAL

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT SPECIFIC TYPE III EPD

FIBER REINFORCEMENT PRODUCTS FOR CONCRETE

FIBERS

PSI™ FIBERSTRAND™
TUF-STRAND™ SF

ACCORDING TO
ISO 21930
ISO 14025

Environmental
Product
Declaration

1.0 GENERAL INFORMATION

Manufacturer:	**Euclid Chemical Company** 19215 Redwood Road Cleveland, OH, 44110 www.euclidchemical.com
EPD Author:	**Julie K. Buffenbarger** Jbuffenbarger@betonconsultingeng.com 216-701-1537 **Beton Consulting Engineers** 2535 Pilot Knob Rd Ste 108, Mendota Heights, MN 55120
Declaration Number:	NRMCAEPD:20080
Reference PCR:	ISO 21390: 2017
Sector:	Construction Industry
Category of EPD:	Third party verified EPD
Scope of EPD:	Cradle to gate (A1-A3)
Date of Issuance:	1/31/2023
End of Validity:	1/31/2028
Production Facility:	**Euclid Chemical Company** Fiber Manufacturing Facility 3361 US 27, Lafayette, Georgia 30728
Product Names:	PSI™ Fiberstrand™ Multi-Mix 80, PSI™ Fiberstrand™ 100, PSI™ Fiberstrand™ 150, PSI™ Fiberstrand™ F, and TUF-STRAND™ SF
EPD Owner:	Euclid Chemical Company
Declared Unit:	1.0 kg
EPD Scope	Cradle-to-Gate (A1, A1, and A3)
Verification	ISO 21930 serves as the core PCR. Independent verification of this EPD and data, is in accordance with ISO 14025. ☐ Internal Verification ☑ External Verification

Comparability of EPDs:

Environmental declarations from different programs may not be comparable. Differences in certain assumptions, data quality, and variability between LCA data sets may still exist. For example, other LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared. As such, caution should be exercised when evaluating EPDs from other manufacturers, as the EPD results may not be entirely comparable. It is always important to understand the underlying details when comparing products, LCAs or EPDs. Expert analysis or interpretation can assist in avoiding unintended misrepresentation of results.

Chemicals of Concern:

The products do not contain any hazardous substances according to the Resource Conservation and Recovery Act, Subtitle 3. The products do not release dangerous substances to the environment, including indoor air emissions, gamma or ionizing radiation, or chemicals released into the air or leached to water and soil.

Program Operator:

National Ready Mixed Concrete Association
66 Canal Center Plaza, Suite 250,
Alexandria, VA 22314

Independent LCA Reviewer and EPD Verifier

Denice Viktoria Staaf
LEED AP BD+C
dstaaf@labelingsustainability.com

Labeling Sustainability
11301 W Olympic Blvd.
Los Angeles, CA, USA

2.0 PRODUCT INFORMATION

2.1 COMPANY DESCRIPTION

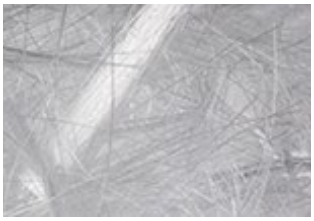
The Euclid Chemical Company, based in Cleveland, Ohio, is a leading manufacturer of products for the concrete and masonry construction industry in North America. For over a century, Euclid Chemical has developed strong relationships with contractors, specifiers, owners, building materials suppliers and concrete producers offering high quality products and industry leading technical support.

2.2 PRODUCT DESCRIPTION

PSI FIBERSTRAND FIBERS are synthetic monofilament and fibrillated polypropylene microfibers for concrete, mortar, and grout that comply with ASTM C 1116, Standard Specification for Fiber Reinforced Concrete and Shotcrete, and are specifically designed and used for plastic shrinkage crack control and secondary reinforcing applications for slabs and pre-cast concrete. PSI Fiberstrand microfibers have been shown to significantly reduce plastic shrinkage cracking when compared to plain concrete.

The PSI Fiberstrand Multi-Mix 80, PSI Fiberstrand 100, PSI Fiberstrand 150, and PSI Fiberstrand F are identical in chemical composition and are similarly manufactured and packaged. The fiber products are differentiated by fiber diameter, length, and degree of fibrillation. Dosage rates will vary depending on the fiber type and reinforcing requirements and can range from 0.5 to 1.5 lbs./yd^3 (0.3 to 0.6 kg/m^3). PSI FIBERSTRAND microfibers also comply with applicable portions of the International Code Council (ICC) Acceptance Criteria AC32 for synthetic fibers.

PSI FIBERSTAND
MULTI-MIX 80



PSI FIBERSTAND
100

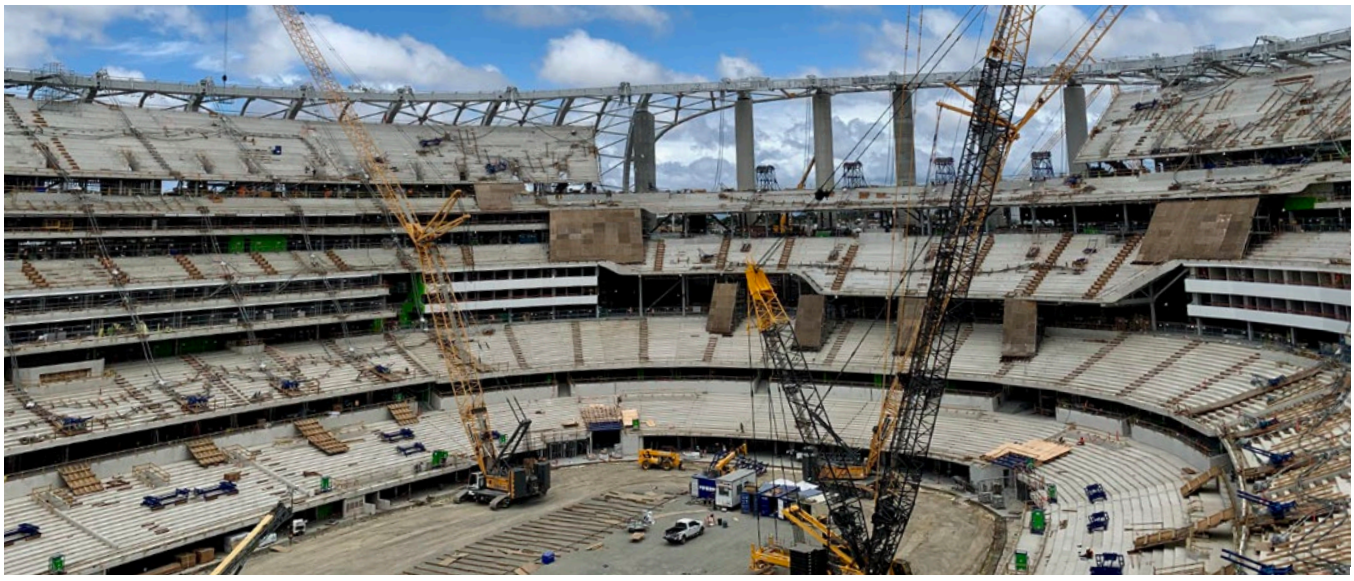
PSI FIBERSTAND
150

PSI FIBERSTAND
F

PSI Fiberstrand microfibers used in the 2021 New American Home, Winter Park, FL

TUF-STRAND SF is a patented polypropylene and polyethylene synthetic macrofiber that is UL certified for composite steel deck construction and is used for replacement of limited structural steel in pre-cast, slabs on ground, pavements and shotcrete applications. successfully used to replace steel fibers, welded wire mesh and conventional reinforcing bars in a wide variety of applications. TUF-STRAND SF fibers comply with ASTM C1116, Standard Specification for Fiber Reinforced Concrete and Shotcrete, and are specifically designed to provide equivalent tensile and bending resistance to conventional reinforcement requirements. Concrete reinforced with TUF-STRAND SF will have three-dimensional reinforcing with enhanced flexural toughness, impact and abrasion resistance and will also help mitigate the formation of plastic shrinkage cracking in concrete. Dosage rates will vary depending upon the reinforcing requirements and can range from 3.0 to 20.0 lbs/yd^3 (1.8 to 12.0 kg/m^3). TUF-STRAND SF synthetic macrofibers comply with the International Code Council (ICC) Acceptance Criteria AC383 for synthetic fibers, are UL certified for composite metal deck construction and are recognized within ACI 360 and IBC 2015 as an alternative reinforcement.

TUF-STRAND SF



TUF-STRAND SF used in the construction of Sofi Stadium, Inglewood, CA

2.3 TECHNICAL DATA

Table 1 provides physical property data for the PSI Fiberstrand synthetic microfiber products. Further product and technical information can be found at www.euclidchemical.com/products/concrete-fibers/.

TABLE 1. TECHNICAL DATA FOR FIBERSTRAND SYNTHETIC MICROFIBER PRODUCTS

	PSI Fiberstrand Multi-Mix 80	PSI Fiberstrand 100	PSI Fiberstrand 150	PSI Fiberstrand F
Raw Material	Virgin Polypropylene	Virgin Polypropylene	Virgin Polypropylene	Virgin Polypropylene
Specific Gravity	0.91	0.91	0.91	0.91
Fiber Length, in. (mm)	0.25, 0.50 (6, 13)	0.25, 0.50, 0.75, and Multi-length (ML) Blend (6, 13, 19, ML)	0.25, 0.75, and Multi-length (ML) Blend (6, 19, ML)	0.25, 0.50, 0.75, 1.5, 2.0, and Multi-length (ML) Blend (6, 13, 19, 38, 51, ML)
Typical Dosage Rate, lbs/yd³ (kg/m³)	0.5 (0.3)	1.0 (0.6)	0.67 - 1.0 (0.4 - 0.6)	1.50 (0.90)
Melting Point, °F (°C)	320 (160)	320 (160)	320 (160)	320 (160)
Electrical/Thermal Conductivity	Low	Low	Low	Low
Water Absorption	Negligible	Negligible	Negligible	Negligible
Acid and Alkali Resistance	Excellent	Excellent	Excellent	Excellent
Color	White	White	White	White
Specification/Compliances	ASTM C1116 ASTM D7508	ASTM C1116 ASTM D7508 ICC Acceptance Criteria 32 UL Certified	ASTM C1116 ASTM D7508 ICC Acceptance Criteria 32	ASTM C1116 ASTM D7508 ICC Acceptance Criteria 32

Table 2 provides physical property data for the TUF-STRAND SF synthetic macrofiber product. Further product and technical information can be found at www.euclidchemical.com/products/concrete-fibers/.

TABLE 2. TECHNICAL DATA FOR TUF-STRAND SF SYNTHETIC MACROFIBER PRODUCT

	TUF-STRAND SF
Raw Material	Polypropylene/Polyethylene
Specific Gravity	0.92
Fiber Length, In. (mm)	2.0 (51)
Aspect Ratio	74
Tensile Strength	87-97 ksi (600-650 MPa)
Modulus of Elasticity (EN14889.2)	13810 ksi (9.5 GPa)
Typical Dosage Rate, lbs./yd³ (kg/m³)	3.0 to 20.0 (1.8 to 12.0)
Melting Point, °F (°C)	320 (160)
Electrical/Thermal Conductivity	Low
Water Absorption	Negligible
Acid and Alkali Resistance	Excellent
Color	White
Specification/Compliances	ASTM C1116, ASTM D7508, IBC 2015 SDI/ANSI-C1.0, ICC AC383 (ESR4072), UL/ULC (CBXQ.R13773)

3.0 LCA CALCULATION RULES

3.1 DECLARED UNIT

All results in this EPD are expressed per 1 kg of packaged product, ready for dispatch to the customer. This reference flow allows for easy multiplication of the environmental profiles with the quantity of fibers relevant to the specific application declared unit is 1 kg of PSI Fiberstrand synthetic microfiber or 1 kg of Tuf-strand synthetic macrofiber.

3.2 SYSTEM BOUNDARY

The system boundary of this cradle-to-gate EPD is shown in Figure 3. It covers the product stage (A1-A3) of the life cycle assessment (LCA) as shown in Table 3. All relevant processes from the raw materials used in the manufacturing and the packaging of the fibers is included in the assessment.

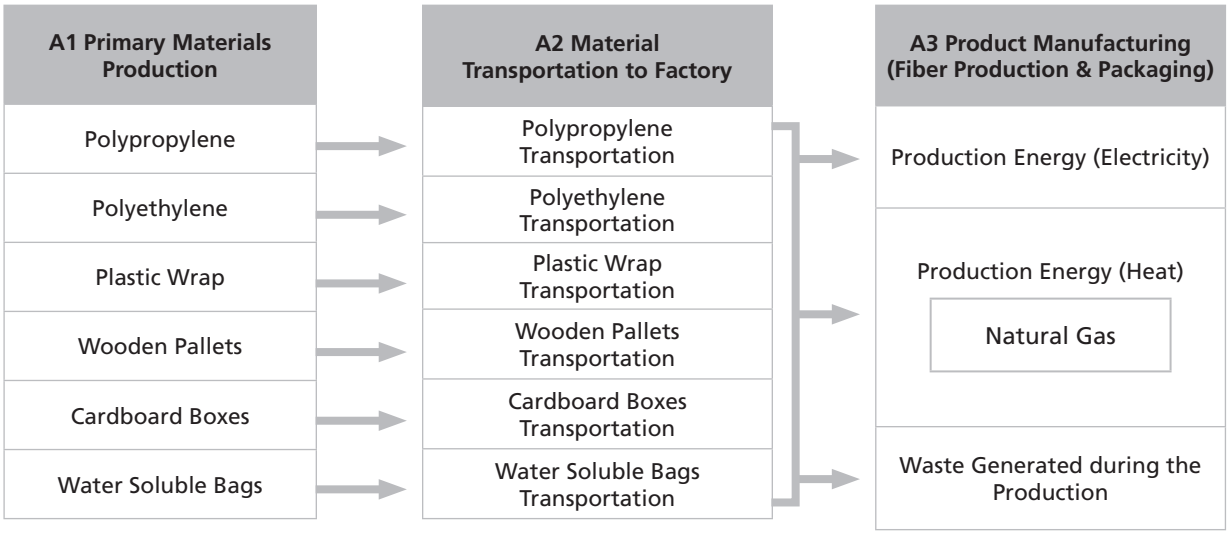


FIGURE 3 CRADLE-TO-GATE PRODUCT SYSTEM FOR FIBER

TABLE 3. DESCRIPTION OF THE SYSTEM BOUNDARY

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw Material Supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction Demoliton	Transport	Waste Processing	Disposal	Reuse Recovery Recycling Potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
			Scenario		Scenario							Scenario				
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

X = INCLUDED IN LCA; MND = MODULE NOT DECLARED; MNR = MODULE NOT REPORTED

3.3 LIFE CYCLE INVENTORY DATA ESTIMATES AND ASSUMPTIONS

All key production data was gathered from the manufacturer based on measured values in 2021. The life cycle inventory data has been primarily sourced from the data sources shown in Table 4 and Table 5.

3.4 CUT OFF CRITERIA

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded the system boundary.

The allocation procedure for co-products and between product systems was considered as per ISO 21930, Sections 7.2.4. For waste generated during the production processes and the secondary data sources, the "cut-off" system model was applied.

3.5 MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the production stage cover the conversion and manufacturing of raw materials into polypropylene microfibers and polypropylene/polyethylene macro fibers which are then packaged for shipment. The manufacturing process includes all raw materials and utilities including water consumption for the product conversion from raw materials to finished goods. Any waste created in the production process is included in the analysis. The study also considers losses due to electricity transmission to the production facility based on the corresponding life cycle profiles.

3.6 TRANSPORT AND INSTALLATION (A4-A5)

Impacts from modules A4-A5 are not included in the scope of this EPD.

3.7 PRODUCT USE AND MAINTENANCE (B1-B7)

These modules are not relevant for this family of products and are not covered in this EPD Air, soil, and water impacts during the use phase have not been studies.

3.8 PRODUCT END OF LIFE (C1-C4, D)

The product end of life stages are not included in this EPD based on the ISO 21930 provision for construction products and materials which fulfill the conditions for the exemption based on the product being integrated and not capable of separation from concrete at end of life, the product not being identifiable as original based on the physical change after construction and the omission of any biogenic carbon in the product. C1-C4 and D – these stages are not covered in this EPD.

3.9 AVERAGES AND VARIABILITY

The EPDs are product and factory specific and do not contain average calculations.

4.0 LCA RESULTS: ENVIRONMENTAL IMPACT DATA

Table 4. LCA Results for PSI Fiberstrand Products
(including PSI Fiberstrand Multi-Mix 80, PSI Fiberstrand 100, PSI Fiberstrand 150, and PSI Fiberstrand F)

Life Cycle Category Indicators and Inventory Metrics				Results/ kg fiber
Core Mandatory Impact Indicator	**Abbreviation**	**Unit**	**Method/Source**	
Global warming potential	GWP	kg CO_2e	TRACI 2.1 V1.02	2.83582
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	TRACI 2.1 V1.02	7.60E-08
Acidification potential of soil and water sources	AP	kg SO_2e	TRACI 2.1 V1.02	0.01040
Eutrophication potential	EP	kg Ne	TRACI 2.1 V1.02	0.00049
Formation potential of tropospheric ozone	SFP	kg O_3e	TRACI 2.1 V1.02	0.00081
Abiotic depletion potential (ADPfossil) for fossil	ADPf	MJ, NCV	CML-IA Baseline V3.02	80.93099
Abiotic depletion potential (ADPelements)	ADPe	kg Sbe	CML-IA Baseline V3.02	1.53E-05
Use of Primary Resources				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	CED V1.10 NCV	3.31114
Renewable primary energy carrier used as material	RPRM	MJ, NCV	LCI Indicator	0.00205
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	CED V1.10 NCV	90.81762
Renewable primary energy carrier used as material	NRPRM	MJ, NCV	LCI Indicator	2.27619
Secondary Material, Secondary Fuel and Recovered Energy				
Secondary material	SM	kg	LCI Indicator	0.00000
Renewable secondary fuel	RSF	MJ, NCV	LCI Indicator	0.00000
Non-renewable secondary fuel	NRSF	MJ, NCV	LCI Indicator	0.00000
Recovered energy	RE	MJ, NCV	LCI Indicator	0.00000
Mandatory Inventory Parameters				
Consumption of freshwater resources;	FW	m^3	LCI Indicator	0.02499
Indicators Describing Waste				
Hazardous waste disposed	HWD	kg	LCI Indicator	3.30E-05
Non-hazardous waste disposed	NHWD	kg	LCI Indicator	0.00362
High-level radioactive waste	HLRW	m^3	LCI Indicator	5.46E-06
Intermediate- and low-level radioactive waste	ILLRW	m^3	LCI Indicator	0.00000
Components for re-use	CRU	kg	LCI Indicator	0.00000
Materials for recycling	MR	kg	LCI Indicator	0.02161
Materials for energy recovery	MER	kg	LCI Indicator	0.00422
Recovered energy exported from the product system	EE	MJ, NCV	LCI Indicator	0.00000

TUF-STRAND SF used in the pavement of US52, Fowler, IN

Table 5. LCA Results for Tuf-Strand SF Product

Life Cycle Category Indicators and Inventory Metrics				Results/ kg fiber
Core Mandatory Impact Indicator	**Abbreviation**	**Unit**	**Method/Source**	
Global warming potential	GWP	kg CO_2e	TRACI 2.1 V1.02	3.08306
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	TRACI 2.1 V1.02	2.65E-06
Acidification potential of soil and water sources	AP	kg SO_2e	TRACI 2.1 V1.02	0.01146
Eutrophication potential	EP	kg Ne	TRACI 2.1 V1.02	0.00060
Formation potential of tropospheric ozone	SFP	kg O_3e	TRACI 2.1 V1.02	0.00086
Abiotic depletion potential (ADPfossil) for fossil	ADPf	MJ, NCV	CML-IA Baseline V3.02	81.11105
Abiotic depletion potential (ADPelements)	ADPe	kg Sbe	CML-IA Baseline V3.02	2.13E-05
Use of Primary Resources				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	CED V1.10 NCV	3.63627
Renewable primary energy carrier used as material	RPRM	MJ, NCV	LCI Indicator	0.00205
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	CED V1.10 NCV	91.28805
Renewable primary energy carrier used as material	NRPRM	MJ, NCV	LCI Indicator	2.27619
Secondary Material, Secondary Fuel and Recovered Energy				
Secondary material	SM	kg	LCI Indicator	0.00000
Renewable secondary fuel	RSF	MJ, NCV	LCI Indicator	0.00000
Non-renewable secondary fuel	NRSF	MJ, NCV	LCI Indicator	0.00000
Recovered energy	RE	MJ, NCV	LCI Indicator	0.00000
Mandatory Inventory Parameters				
Consumption of freshwater resources;	FW	m^3	LCI Indicator	0.02199
Indicators Describing Waste				
Hazardous waste disposed	HWD	kg	LCI Indicator	5.48E-05
Non-hazardous waste disposed	NHWD	kg	LCI Indicator	0.00380
High-level radioactive waste	HLRW	m^3	LCI Indicator	5.46E-06
Intermediate- and low-level radioactive waste	ILLRW	m^3	LCI Indicator	0.00000
Components for re-use	CRU	kg	LCI Indicator	0.00000
Materials for recycling	MR	kg	LCI Indicator	0.02176
Materials for energy recovery	MER	kg	LCI Indicator	0.00378
Recovered energy exported from the product system	EE	MJ, NCV	LCI Indicator	0.00000

TUF-STRAND SF used in the floor construction of CA35 - Condomínio Anhanguera, Cajamar City, Brazil

5.0 REFERENCES

1. ISO 21930: 2017 Building Construction – Sustainability in Building Construction Environmental Declaration of Building Products
2. ISO 14025: 2006 Environmental Labeling and Declarations – Type III Environmental Declarations – Principles and Procedures.
3. ASTM C 1116/C1116M-10a, Standard Specification for Fiber Reinforced Concrete and Shotcrete, ASTM International, West Conshohocken, Pa.
4. ASTM D7508/D7508M-20, Standard Specification for Polyolefin Chopped Strands for Use in Concrete, ASTM International, West Conshohocken, Pa.

EUCLID CHEMICAL

For more than a century, The Euclid Chemical Company has served the global building market with a full line of quality products for the concrete and masonry construction industry. Core companies operate in the USA (HQ), Canada, Mexico, Ecuador, Central America, Colombia, and Chile.

Euclid Chemical designs and manufactures admixtures, integral color, concrete fibers, curing and sealing compounds, structural grouts, epoxy adhesives, floor hardeners and toppings, joint fillers, industrial and architectural coatings, waterproofing products, decorative color/stains/stamps, and a comprehensive selection of concrete restoration materials. The company competes in key industrial, commercial, medical, transportation, and institutional markets.

Marketed under the Euco, Eucon, Accelguard, Plastol, Tuf-Strand, Fiberstrand, Dural, Baracade, Tamms, Vandex, Increte, Key Resin, QWIKjoint, EucoRepair, and Speed Crete brand names, a full line of products for both new construction and the repair of concrete are available through a domestic and international network of building material suppliers.

EUCLID CHEMICAL

19215 Redwood Road
Cleveland, OH 44110
t 800-321-7628
f 216-481-7072