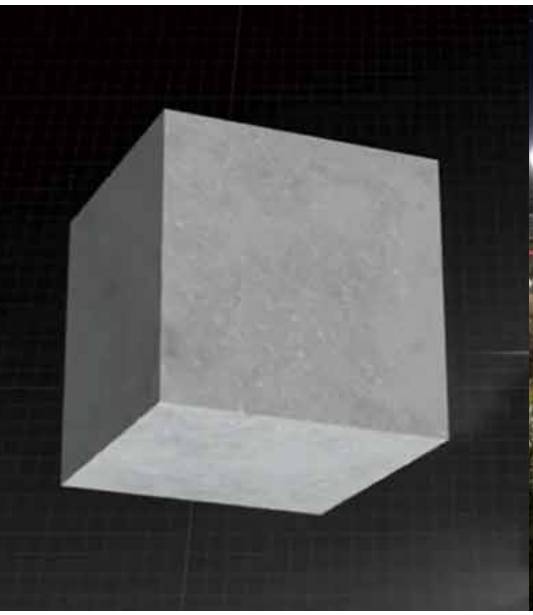
Kanaflex®

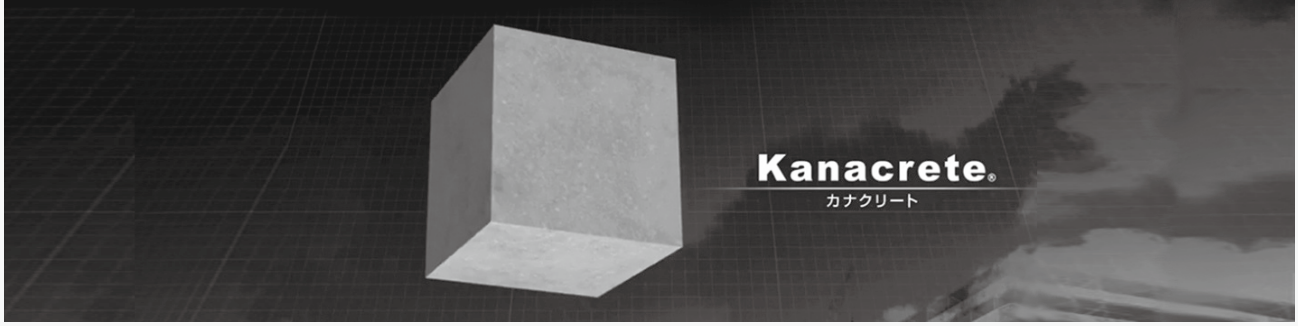
Materials for road and river works



Kanacrete®

Kanacrete® Road Bridge Floor Plate

Kana Hume® Type A with Quake-proof Quick Joint Coupling



What is Kanacrete®?

Kanacrete® is an ultra-lightweight fiber-reinforced concrete, which is a lightweight ceramic material that has achieved a “structure with no reinforcing bars” by compounding special fibers.

Despite its lightweight, it has approximately 3 times the bending strength and approximately twice the compressive strength of ordinary concrete and it also has excellent thermal insulation and fire resistance.
Taking advantage of those characteristics, Kanaflex has developed a variety of products.
Kanaflex’s products are used in various fields such as construction materials and common-use cable tunnels.

Material and characteristics

As Kanacrete® is a high-strength and lightweight fiber concrete made by compounding special fibers, it **has achieved approximately twice the compressive strength and approximately three times the bending strength of reinforced concrete.**

Compressive strength test

Bending fracture strength

Accelerated carbonation test

Tested by the Japan Testing Center for Construction Materials in accordance with JIS A 1153 (Method of accelerated carbonation test for concrete)

This test measures the carbonation depth when carbonation in concrete is accelerated by increasing the concentration of carbon dioxide in the atmosphere.
52 weeks = 1 year, corresponding to 100 years in the outdoor environment.

The carbonation depth of Kanacrete® products was 0 mm in 52 weeks. The test result proves that Kanacrete® will not have carbonation in natural environments (outdoor) for more than **100 years.**

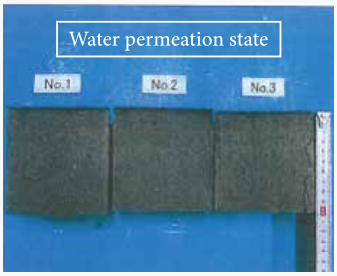
Permeability test

According to the test results, the maximum value of the average permeation depth was 4.0 mm.
Since Kanacrete® is made up of closed cells similar to those of urethane foams, it does not penetrate more than that.
The permeability coefficient of Kanacrete® calculated with 1.66 × 10-5 cm²/sec, which is the average value of the diffusion coefficients, is about 1.8 × 10-13 cm/sec.
In addition, because of its structure with no reinforcing bars, there will be no concrete deterioration due to rust and corrosion.

The permeability coefficient of Kanacrete® is 1.8 × 10^{-13} cm/sec.

Result of the permeability test
Test site: Japan Testing Center for Construction Materials　Test method: Permeability test (Input method)

No.	Water permeation depth mm										Diffusion coefficient $\times 10^{-5} m^2/s$
	a	b	c	d	e	f	g	h	i	Average	
No 1	2.0	4.1	2.0	2.1	2.2	2.7	3.6	2.3	2.0	2.6	1.0
No 2	5.0	2.1	1.7	2.1	3.0	4.9	4.6	5.0	7.5	4.0	2.4
No 3	1.5	4.2	3.3	6.8	2.6	4.6	2.1	1.7	1.6	3.2	1.6



The water permeation resistance of Kanacrete® is approximately 13 times higher than that of general concrete.

The permeability coefficient of general concrete is 2.4 × 10^{-12} cm/sec.
Based on Table-3 Permeability coefficient obtained by various permeability test methods in the article “Long-term saturated permeability of concrete” in the Concrete Research and Technology vol. 22, No. 2, 2000.

Freezing and thawing test

“Frost damage” is one of the typical forms of deterioration of concrete structures.
Permeated moisture freezes, causing problems such as scaling and cracking.
The products undergo acceleration tests by repeating rapid freezing and thawing in accordance with JIS A 1148, and are evaluated using the dynamic modulus of elasticity and mass changes as indicators.

Test site:　Japan Testing Center for Construction Materials
Test method: Underwater freezing and thawing test method (Method A)
Test method for dynamic modulus of elasticity, dynamic shear modulus of elasticity, and dynamic Poisson’s ratio of concrete by resonance vibration

Result of repeating 300 cycles of 5 → -18 → 5°C

The mass decrease rate was -1.4% or less, and the relative dynamic modulus of elasticity increased to 116% with no decrease.

The result of this test has proved that Kanacrete® is resistant to freezing and thawing in cold regions.

High-strength Fiber Reinforced Concrete Slab

Kanacrete® Slab for Road Bridge

High-strength fiber concrete “Kanacrete®” has achieved long-life, lightweight, and low-cost slabs for road bridges!

The Kanacrete® slab for road bridges is a revolutionary precast slab that will not have carbonation for more than 100 years by using high-strength fiber concrete “Kanacrete®” which is developed independently by our company. Furthermore, it is lighter and more inexpensive than reinforced concrete slabs, making it an optimal material for infrastructure renewal in our country beyond its service life.

Shortening of the construction period

Because of its lightweight, the product can minimize the reinforcement work of bridge piers and bridge girders, and enables very simple joint work.

Approximately 30% lighter
than conventional RC8*1 slab

Kanacrete® slab is lightweight, which reduces the dead load on the bridge girder.

Improvement of earthquake resistance

By reducing the dead load on the bridge girder, the earthquake resistance of the main body of the bridge is improved!

Lifespan five*2 times longer
than conventional RC8*1 slabs

Durability to withstand loads and high fatigue resistance
For details, refer to the "Wheel load running test of Kanacrete slab" on the left-hand page.

*1 RC8 is an RC slab designed according to the specifications for highway bridges in 1996.
*2 Lifespan five times longer means fatigue strength calculated by the S-N curve of public works research institute.

Kanacrete® has been proved by the accelerated carbonation test to have no carbonation for more than 100 years.

Tested by the Japan Testing Center for Construction Materials in accordance with JIS A 1153
(Method of accelerated carbonation test for concrete)

The accelerated carbonation test measures the carbonation depth when carbonation in concrete is accelerated by increasing the concentration of carbon dioxide in the atmosphere. 52 weeks = 1 year, corresponding to 100 years in an outdoor environment.
The carbonation depth of Kanacrete® products was 0 mm in 52 weeks.
The test result proves that Kanacrete® will not have carbonation in natural environments (outdoors) for more than 100 years.

Wheel load running test of Kanacrete slabs

Type proposed by Public Works Research Institute:
Wheel load running test in open collaborative research
"Collaborative research on durability improvement technology of bridge decks using short fiber reinforced concrete"

Despite being 26.5% lighter than an RC8* slab, the test shows that it has durability that can withstand approximately twice the load and fatigue strength approximately five times higher than an RC8 slab.

Slab itself
Tested at: Public Works Research Institute

Achieved 500,000 times of runs with a wheel load of 40 t

- Unit weight: γ=17.80 kN/m^3
- Slab thickness: h = 23 cm
- Standard design strength: σck = 40 N/mm^2
- Allowable compressive stress: σca = 13.3 N/mm^2
- Reinforcing bar: SD345
- Allowable tensile stress: σsa = 200 N/mm^2

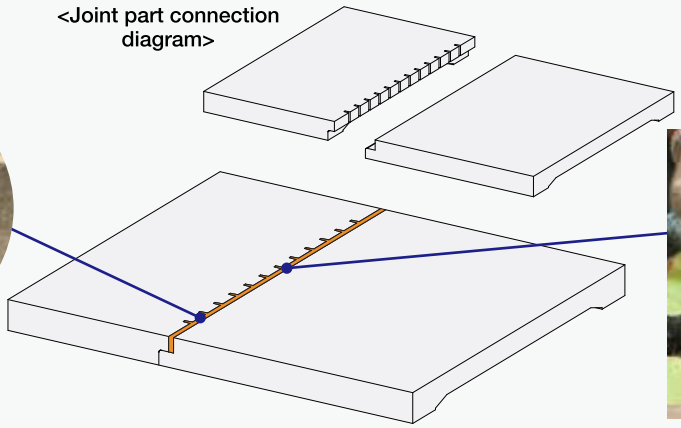
- The distance between reinforcing bars on the compression side is 600 mm to 1,000 mm.
- The number of reinforcing bars is 70% less than that of RC slabs designed according to the specifications for highway bridges.
- Reinforcing bar tensile stress: 192 N/mm^2 (Designed to be 200 N/mm^2 or less)

Slab with joint
Tested at: Public Works Research Institute

Achieved 520,000 times of runs with a wheel load of 40 t

After filling Kanacrete® with filler

<Joint part connection diagram>



Filling Kanacrete with filler

Paper presented by the Japan Society of Civil Engineers

Read the QR code shown on the left to see the details from "Development research of road bridge decks using high-strength lightweight fiber concrete".

Metal-resin composite pipe (civil work supply)

Kana Hume® Type A with quake-proof quick joint coupling

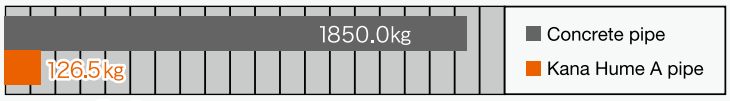
Kana Hume® Type A with quake-proof quick joint coupling is lightweight and has high pressure resistance, corrosion resistance, and workability as well as high watertightness because of the employment of the quake-proof quick joint coupling, and it is also designed taking into consideration economy and the environment.

Ministry of Land, Infrastructure, Transport and Tourism
Registered in New Technology Information System (NETIS)
Registration No. KY-120004-VR

Features of Kana Hume® Type A with quake-proof quick joint coupling

1. Weight reduction

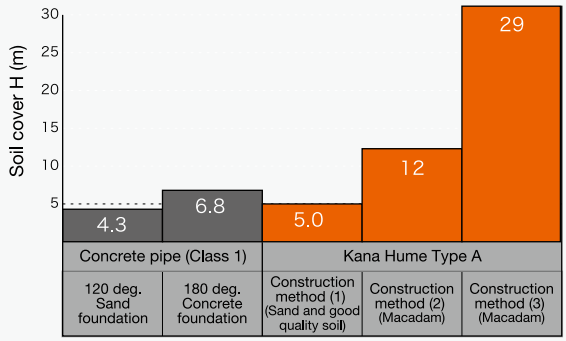
Compared to conventional concrete pipes, it has successfully reduced the weight for the pipe of ø1,000 by 90%.



●Comparison between a single concrete pipe of 2.43 m and a single pipe of Kana Hume® Type A of 5 m

2. Pressure resistance

Our unique metal-resin composite technology and new rib structure enable construction of higher embankments compared with concrete pipes (Calculated with an allowable deformation rate of 5.0% for Kana Hume® Type A. A pipe of ø1,000 was used for comparison.)



- When using construction method (1), calculate with E' = 300 N/cm^2
- When using construction method (2), calculate with E' = 700 N/cm^2.
- When using construction method (3), calculate with E' = 1,400 N/cm^2.

(E': Modulus of soil reaction)

3. Watertightness

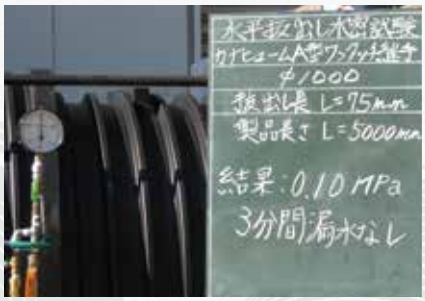
The product has cleared the condition of internal water pressure 0.1 MPa with the employment of the quake-proof quick joint coupling.

■ Bending watertightness test

In this test, a pressure of 0.1 MPa is applied at a bending angle of 1 deg. When the length of the sample is 1,300 mm, the displacement amount is 26 mm, and the sample is kept in the pressurized state for 3 minutes and has no water leakage.

■ Horizontal pull-out watertightness test

In this test, 1.5% of the product length is pulled out and a pressure of 0.1 MPa is applied. When the product length is 5,000 mm, 75 mm is pulled out, and the product is kept in the pressurized state for 3 minutes and has no water leakage.

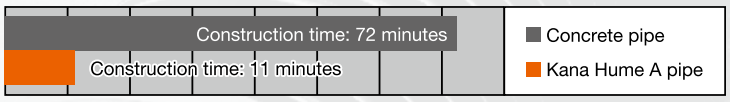


4. Corrosion resistance

High-density polyethylene is used for the internal and external surfaces of the product. Its characteristics solve the problems of corrosion and deterioration due to acid rain, hydrogen sulfide, industrial wastewater, and hot spring water.

5. Workability (construction time reduced up to approx. 1/7)

As Kana Hume® Type A is long in specified length for a single pipe and light in mass, it can facilitate construction work and is excellent in workability, making it possible to drastically reduce construction time.



*The construction time is a measured value in test construction.

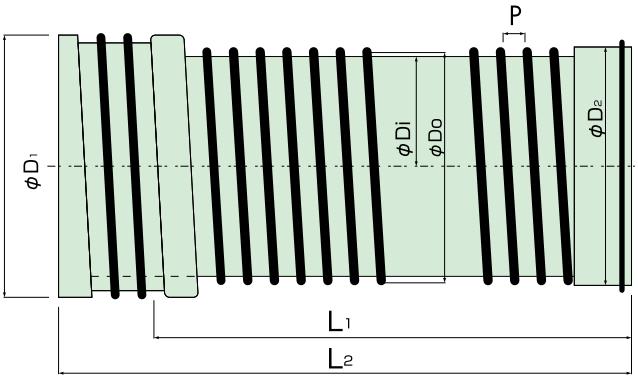
Construction condition: Extended length of laying L = 15.0 m
Pipe specifications -7 concrete pipes (ø1,000) (Total weight: 11,620 kg)
-3 pipes of Kana Hume® Type A (ø1,000) (Total weight: 380 kg)

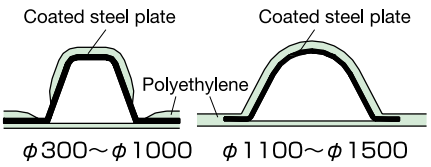
*We recommend the use of lubricant (Resi-Lube) on connections.

6. Consideration to economy and environment

Excellent in workability because of its lightweight and long length, making it possible to reduce the size of laying machines and to reduce transportation costs, and greatly contributes to the protection of the global environment, including reduction in construction period and CO_2 emissions.

Structural diagram





Specification table

Specifications of Kana Hume Type A® with quake-proof quick joint coupling

Nominal	Main pipe			Quick joint coupling		Total length		Reference mass (kg/pipe)
	Do(mm)	Di(mm)	Pitch (mm)	D1(mm)	D2(mm)	L1(mm)	L2(mm)	
φ300	333	300	60	403	352	5000	5145	28
φ400	434	400	60	503	452	5000	5145	39
φ500	537	500	65	606	555	5000	5145	50
φ600	659	600	100	726	666	5000	5155	70
φ700	759	700	100	840	780	5000	5155	91
φ800	877	800	110	947	886	5000	5165	110
φ900	977	900	110	1062	1001	5000	5175	129
φ1000	1095	1000	110	1164	1102	5000	5200	144
φ1100	1200	1100	160	1345	1236	5000	5245	252
φ1200	1320	1220	160	1465	1356	5000	5245	289
φ1350	1493	1372	175	1632	1522	5000	5275	348
φ1500	1656	1524	195	1801	1690	5000	5305	413

■ The length of L1 is the effective length.
*Perforated pipe: We produce pipes with holes on the whole circumference and pipes with holes on two-thirds as custom-made products.
*The specifications shown above are all made-to-order products.

Applications

Road sewage and rainwater drainage line/Waste disposal site drainage line

Drainage line for the development of residential land and in the premise of plant

Drainage line of large-scale developed land (airport, park, etc.)/River works

Physical properties

Material characteristics

	Item	Method	Unit	Characteristic
Polyethylene	Density	JIS K 6922-2	g/cm^3	0.942 or more
	Tensile yield stress	JIS K 6922-2	MPa	19.6 or more
	Elongation	JIS K 6922-2	%	300 or more
	Vicat softening point	JIS K 6922-2	℃	115 or more
Special steel plate	Tensile strength	JIS Z 2241	N/mm^2	*1 270 or more

*1: The characteristic value is based on JIS G 3302.

Chemical resistance (polyethylene)

Chemical name		Temperature 20℃	Temperature 60℃	Chemical name	Temperature 20℃	Temperature 60℃	Chemical name	Temperature 20℃	Temperature 60℃
Sulfuric acid	10~50%	○	○	Acetic acid	10% ○	○	Hydrogen peroxide	30% ○	○
Hydrochloric acid	10%	○	○	Glacial acetic acid	△	×	Gasoline		△	×
	35%	○	○	Caustic soda	50% ○	○	Acetone		△	×
Nitric acid	10%	○	○	Caustic potash	10% ○	○	Aniline		○	×
	40%	○	△	Sodium carbonate	○	○	Carbon tetrachloride		×	×
Hydrogen fluoride	75%	○	△	Calcium chloride	○	○	Glycerin		○	△
Phosphoric acid	30%	○	○	Methyl alcohol	○	△	Benzene		×	×
Formic acid	40%	○	○	Ammonia water	○	○				

○ … OK to Use △ … Slightly Inferior but OK to Use with Caution × … Do Not Use

Construction site

* You can also choose Kana Hume Type A® plane end type according to the site conditions.

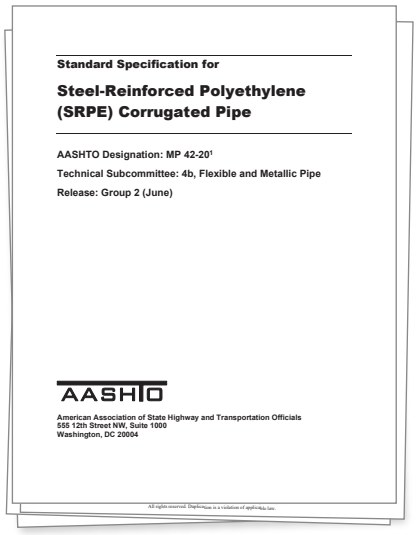
Kana Hume® Type A has acquired AASHTO MP-42 specification and certified for use in all over the United States.

AASHTO (American Association of State Highway and Transportation Officials) is a nonprofit organization having an almost 100-year history, which deliberates on new products used at the U.S. federal level. It is one of the world's leading organizations in setting technical standards for all phases of highway system development. It also sets standards for all forms of public transport. Technical standards are established for design, construction of highways and bridges, materials, and other technical areas.

Since Kana Hume® Type A is a product using a completely new technology in the history of U.S. infrastructure, it has acquired the AASHTO MP-42 specification in January 2020 after deliberations for several years.

Subsequently, the existence of AASHTO MP-42 specification was announced to the DOT (United States Department of Transportation) of each state at the U.S. federal level, and the DOT laboratories of each state developed inspection items and certification processes at the state level. Focusing on the FDOT (Florida Department of Transportation Standard Specification for Road and Bridge) as a target, which is said to be particularly difficult to acquire accreditation, the product was accredited in January 2022.

The document that shows the product meets the FDOT requirements and the summary of the durability test and experiment are provided on the right-hand page.



Standard Specification for

Steel-Reinforced Polyethylene (SRPE) Corrugated Pipe

AASHTO Designation: MP 42-20[1]

Technical Subcommittee: 4b, Flexible and Metallic Pipe

Release: Group 2 (June)

AASHTO

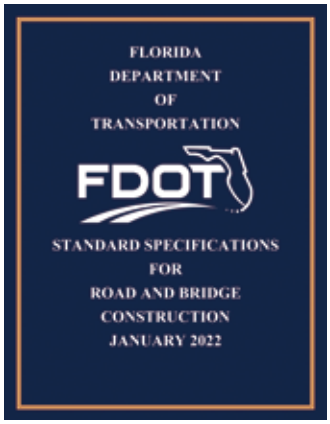
American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

Standard specifications of AASHTO MP-42 announced as a product certified for use all over the United States

In the U.S. federal standard, the word MP-42 is used in the specifications, but it indicates Kana Hume® Type A in all of the specifications including the contents and raw materials.

Kana Hume® Type A meets the FDOT requirements.

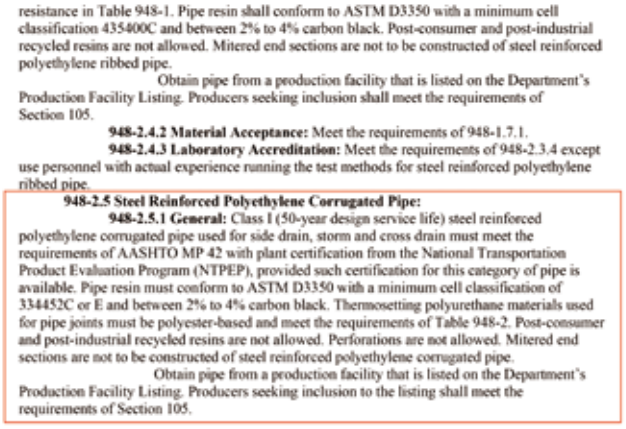
In addition, in 2022, AASHTO MP-42<Kana Hume® Type A> specification was certified as Class 1(50-year durability) on the standard specifications for road and bridge construction by the Florida Department of Transportation.



FLORIDA
DEPARTMENT
OF
TRANSPORTATION

FDOT

STANDARD SPECIFICATIONS
FOR
ROAD AND BRIDGE
CONSTRUCTION
JANUARY 2022



resistance in Table 948-1. Pipe resin shall conform to ASTM D3350 with a minimum cell classification 435400C and between 2% to 4% carbon black. Post-consumer and post-industrial recycled resins are not allowed. Mitered end sections are not to be constructed of steel reinforced polyethylene ribbed pipe.

Obtain pipe from a production facility that is listed on the Department's Production Facility Listing. Producers seeking inclusion shall meet the requirements of Section 105.

948-2.4.2 Material Acceptance: Meet the requirements of 948-1.7.1.

948-2.4.3 Laboratory Accreditation: Meet the requirements of 948-2.3.4 except use personnel with actual experience running the test methods for steel reinforced polyethylene ribbed pipe.

948-2.5 Steel Reinforced Polyethylene Corrugated Pipe:

948-2.5.1 General: Class I (50-year design service life) steel reinforced polyethylene corrugated pipe used for side drain, storm and cross drain must meet the requirements of AASHTO MP 42 with plant certification from the National Transportation Product Evaluation Program (NTPEP), provided such certification for this category of pipe is available. Pipe resin must conform to ASTM D3350 with a minimum cell classification of 334452C or E and between 2% to 4% carbon black. Thermosetting polyurethane materials used for pipe joints must be polyester-based and meet the requirements of Table 948-2. Post-consumer and post-industrial recycled resins are not allowed. Perforations are not allowed. Mitered end sections are not to be constructed of steel reinforced polyethylene corrugated pipe.

Obtain pipe from a production facility that is listed on the Department's Production Facility Listing. Producers seeking inclusion to the listing shall meet the requirements of Section 105.

[Summary in English] Polyethylene corrugated pipes containing steel plates

Kana Hume® Type A of AASHTO MP-42 specifications was certified as Class 1 (50-year durability/Steel reinforced polyethylene pipe).

By the 100-year durability test specified by the Florida Department of Transportation, 264-year durability was verified.

TRI/Environmental, Inc. conducted a 100-year durability test on the corrosion life of Kanaflex high-strength steel reinforced HDPE pipes.

*HDPE pipe is a high-density polyethylene pipe.

From the report of TRI/Environmental, Inc.

TRI TESTING, RESEARCH, CONSULTING AND FIELD SERVICES

Corrosion Service Life of Kanaflex High Strength Steel Reinforced HDPE Pipe

For

Kevin Cornell

Senior Sales Engineer

Kanaflex Corporation-USA Pipe Division

By

Mario Paredes
TRI/Environmental
Senior Research Engineer
Pipe Testing Division

September 30th, 2020

The table below shows the results of the tests on the items specified by the Florida Department of Transportation (FDOT) (Standards on road and bridge construction). It shows the service lives of galvanized copper plates under various conditions (resistance values).

Table 2. Galvanized Specimens Data Summary

Exposure Solution	Corrosion Rate of Zinc (mpy)	Service Life of Zinc (Years)	Corrosion Rate of Steel (mpy)	Service Life of Steel 1 Side (Years)	Service Life of Steel 2 Side (Years)	Service Life of Galvanized Steel (Years)
300 ppm Cl^-	0.289	1.2	0.324	50.2	25.1	51.5
Cyclic 300 ppm Cl^-	0.101	3.6	0.149	109.5	54.7	113.0
1 kOhm-cm	0.022	16.6	0.078	208.1	104.1	224.8
10 kOhm-cm	0.060	6.0	0.063	258.4	129.2	264.4
14 kOhm-cm	0.066	5.5	0.092	177.2	88.6	182.7

264-year durability verified

[Explanation]

As a result of the test under the condition of a resistance value of 10 kOhm-cm, the service life is 264.4 years.

TRI/Environmental, Inc. (TRI) is an independent third-party organization that conducts global materials testing and researches.

Kanaflex Corporation Co., Ltd. https://www.kanaflex.co.jp

Tokyo: 6-10-1 Roppongi, Minato-ku, Tokyo, 106-6117 Japan (Roppongi Hills Mori Tower 17F)
TEL. +81-3-5770-5197 FAX. +81-3-5770-5124

Osaka: 1-8-30 Tenmabashi, Kita-ku, Osaka, 530-6017 Japan (OAP Tower 17F)
TEL. +81-6-6881-0811 FAX. +81-6-6355-0769

Sapporo: 2-5 Kitagojo-nishi, Chuo-ku, Sapporo, 060-0005 Japan
(JR Tower Office Sapporo 17F)
TEL. +81-11-271-8770 FAX. +81-11-271-8783

Sendai: 4-2-3 Tsutsujigaoka, Miyagino-ku, Sendai, 983-0852 Japan
(Sendai MT Bldg. 11F)
TEL. +81-22-792-3055 FAX. +81-22-792-3060

Niigata: 2-1-20 Higashi Odori, Chuo-ku, Niigata, 950-0087 Japan
(Station Plaza Niigata Bldg. 7F)
TEL. +81-25-240-7778 FAX. +81-25-240-7779

Yokohama: 5-85 Choja-machi, Naka-ku, Yokohama, 231-0033 Japan
(Sankyo Yokohama Bldg. 8F)
TEL. +81-45-241-7511 FAX. +81-45-241-7533

Kanazawa: 2-15-1 Honmachi, Kanazawa, 920-0853 Japan
(Porte Kanazawa 8F)
TEL. +81-76-234-5660 FAX. +81-76-234-5977

Nagoya: 3-20-17 Marunouchi, Naka-ku, Nagoya, 460-0002 Japan
(KDX Sakuradori Bldg. 9F)
TEL. +81-52-955-1512 FAX. +81-52-955-1516

Hiroshima: 1-8-13 Kokutaiji-machi, Naka-ku, Hiroshima, 730-0042 Japan
(Aioi Nissei Dowa Sonpo Hiroshima TY Bldg. 4F)
TEL. +81-82-240-0609 FAX. +81-82-240-0610

Shikoku: 1-2-5 Kotobuki-cho, Takamatsu, Kagawa Prefecture, 760-0023 Japan
(Imon Takamatsu Bldg. 3F)
TEL. +81-87-822-2690 FAX. +81-87-822-2691

Fukuoka: 1-3-3 Hakataekimae, Hakata-ku, Fukuoka, 812-0011 Japan
(Meiji Yasuda Watanabe Bldg. 9F)
TEL. +81-92-474-2630 FAX. +81-92-474-2631

Okinawa: 5-10-13 Nishizaki-cho, Itoman, Okinawa Prefecture, 901-0306 Japan
TEL. +81-98-852-3337 FAX. +81-98-852-3358

website