TSK

New Technology Information System (NETIS)
Registration No. KT-050045

Rust Prevention beyond Zinc Plating,
with a Vivid Appearance

Modified saturated polyester resin coating

Toff-coated Products

TOFF
COATED
PRODUCTS

TOKYO ROPE MFG. CO., LTD.

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PRODUCTS

Toff-coated products provide a new form of rust prevention.

Toff-coated products provide excellent resistance to corrosion, acid, and alkali, through rust prevention processing that combines plating with modified saturated polyester resin coating. They can last as long as 35 years in salt-susceptible areas, and more than twice that in ordinary areas. In addition, they can be colored to blend in with the surrounding landscape.

All tests have proven the superb performance of Toff-coated products.

1 **Excellent basic physical properties**
Saturated polyester resins have excellent basic physical properties (mechanical properties, resistance to ultraviolet light, abrasion resistance, chemical stability, etc.).

2 **Weather resistance (ultraviolet light and salt damage)**
In exposure tests on a beach of Miyake Island, Tokyo, the original heath remained almost intact after 16 years (according to Japan's leading telecommunications company, NTT).

3 **Resistance to scratches and high adhesiveness**
Salt spray tests, as done by scratching, have shown that Toff-coated products corrode more slowly than other coatings tested, confirming its high adhesiveness (according to Japan's leading telecommunications company, NTT).

4 **Resistance to peeling and electrolytic corrosion**
A construction field test of railroad rail fastening bolts/plates has revealed that Toff-coated products are more resistant to peeling and electrolytic corrosion than all other products tested (according to Japan Railways Group).

5 **Weather resistance (ultraviolet light and salt damage)**
〈Providing four times the resistant of zinc plating〉
Salt spray tests, accelerated weathering resistance tests, and soil-buried tests were conducted on steel sheets, steel bars, and bolts. Toff-coated products rank the best among the rust prevention methods tested (according to Japanese expressway company, NEXCO).

6 **Weather resistance (ultraviolet light and salt damage)**
Exposure tests were conducted on a coast of Okinawa Prefecture to compare rust prevention methods offered by all suppliers of steel sheets and bolts. Toff-coated products were rated the best and fully adopted (according to the Ministry of Land, Infrastructure, Transport and Tourism and the Okinawa Development Agency).

7 **Weather resistance (ultraviolet light and salt damage)**
Outdoor exposure tests and accelerated corrosion tests on steel sheets were conducted for rust preventive coatings. As a result, Toff-coated products were rated as the best coating, equivalent to aluminum in rust prevention (according to the Steel Barrier Association).

Mighty net
Hachimantai City, Iwate Pref.
Kashima, Matsuyama City, Ehime Pref.

Rope net
Okinoshima, Sukumo City, Kochi Pref.
(Okinoshima Circulation Line)

Pocket type rock net
Hotojima, Tsukumi City, Oita Pref.

Cover type rock net
Hachimantai City, Iwate Pref.

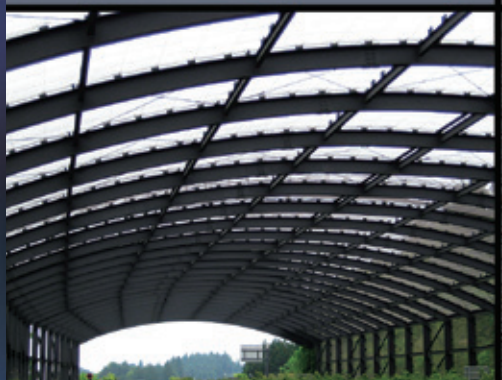
Curtain net
Oga City, Akita Pref. (Oga-hanto Line)

Windbreak fence
Myojin, Ikata-cho, Ehime Pref.

Guard cable
Fukushima City, Fukushima Pref.
(Bandai Azuma Sky Line)

Hanging shelf
Doroyu, Yuzawa City, Akita Pref.

Flying ball block net
Kasama City, Ibaraki Pref.



Rock fence
Oga City, Akita Pref. (Oga-hanto Line)

Steel pipe pile type rock fence
Toyakocho, Hokkaido Pref. (Toya Park Toya Line)

Exposure Test of Toff-coated Rope on the Summit of Mt. Aso

Test outline

In February 2006, an exposure test was conducted, together with continual measurement of the concentration of sulfurous acid and hydrogen sulfide gases on the summit of Mt. Aso.

【Gas generation conditions】

These gases are generated just under every other day on average.

The concentrations at the moment of gas generation were, on average, 10 ppm for sulfurous acid (ranging from 0.5 to 25 ppm; figures above 25 ppm were rounded to 25 ppm), and 5 ppm (ranging from 0.5 to 23 ppm) for hydrogen sulfide.

Note: Mountain climbing and sightseeing are prohibited at concentrations of 5 ppm or above for either sulfurous acid or hydrogen sulfide.

【Corrosion conditions of exposed materials】

1.Exposed material (3x7, ropes of ϕ18 mm diameter):

A.Three types of Toff-coated rope (coating on element wire in dark brown; coating on rope in dark brown/dark green)

B.Zn plating (material for comparison)

C.Zn-Al plating (material for comparison)

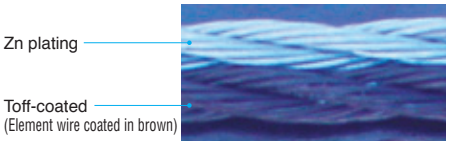
2.Results (see the photos below)

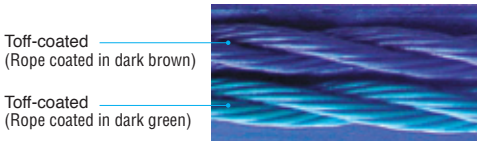
(1) Toff-coated wires, after two years, were all satisfactory with no abnormality.

(2) The Zn plating, after half a year, formed red rust, which completely covered it in two years.

(3) The Zn-Al plating formed a thin layer of red rust in two years.

At start of exposure test





After six months

After one year

After two years

Exposure Test in Severe Salt-susceptible Area for 16 Years

Time of installation: June 1988
Place of installations: NTT exposure test station in Miyake Island, Tokyo.
Date of photographing: July 2003

Scene of Miyake Island test station

■6 years after installation

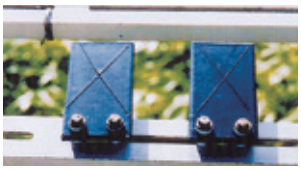
Toff-coated

Fluorine coating

Special urethane coating

■16 years after installation

The Toff-coated products, as many as 16 years later, show almost no deterioration and adhesive force remains satisfactory.



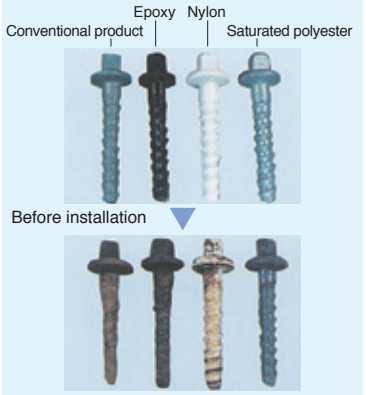
Outline of Japan Railways Group (JR) Corrosion Resistance Test

Materials compared: Epoxy and nylon

■Test outline

Product name	Railroad rail fastening device; tie plate mounting bolts
Installation location	Line section prone to electrolytic corrosion
Test period	June 1989 to February 1990
Test materials	From left in photo: conventional product, epoxy, nylon, and saturated polyester
Test result	Saturated polyester was the best.

Rail fastening device in installation



Basic Performance

■Raw material test certificate

Item	Test name/description	Measuring method	Specification
Limiting viscosity (dl/1)	Alternative value to the molecular weight measured by Uberoze viscometer	Toyobo method	0.83 to 0.87
Melting point (°C)	Measurement of melting temperature of polymer	DSC method	235±3°C
Specific gravity	Measurement by sink-float method	JIS K 5600	1.35±0.05

■Results of coating test (Conditions: coating after zinc plating)

Item	Test name/description	Measuring method	Specification
Impact resistance	80-cm drop (300 g, 1-inch tip diameter)	JIS K 5600	No abnormality allowed
Adhesive strength (N/mm^2)	Tensile test	JIS K 5600	≥ 15
Tensile strength (MPa)	Tensile strength and elongation	JIS K 5600	≥ 50
Wear resistance (μm)	CS-10, 4.90 N, 1000 cycles	JIS K 5600	≤ 100
Pencil hardness	Pencil scratch value	JIS K 5600	≥ 2H

■Other properties

Item	Test name/description	Measuring method	Result
Corrosion resistance	Salt spray test method	JIS Z 2371	No rust or swelling for 6 months
Weather resistance	NTT outdoor exposure test in Miyake Island, Tokyo	JIS K 2381	No abnormality during period from installation to July 2003 (elapse of 16 years)
Immersion test in sea water	3 years, off the coast of Yokohama	—	No abnormality
Combustion gas ingredient	Generation of harmful gas	JIS K 7217	None
Detection of harmful components		JWWA Z 108	All below criteria

JWWA Z 108: Leach test in accordance with Notification No. 45 by the Ministry of Health, Labour and Welfare (MHLW) based on the stipulations in MHLW Ministerial Ordinance No. 15

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