

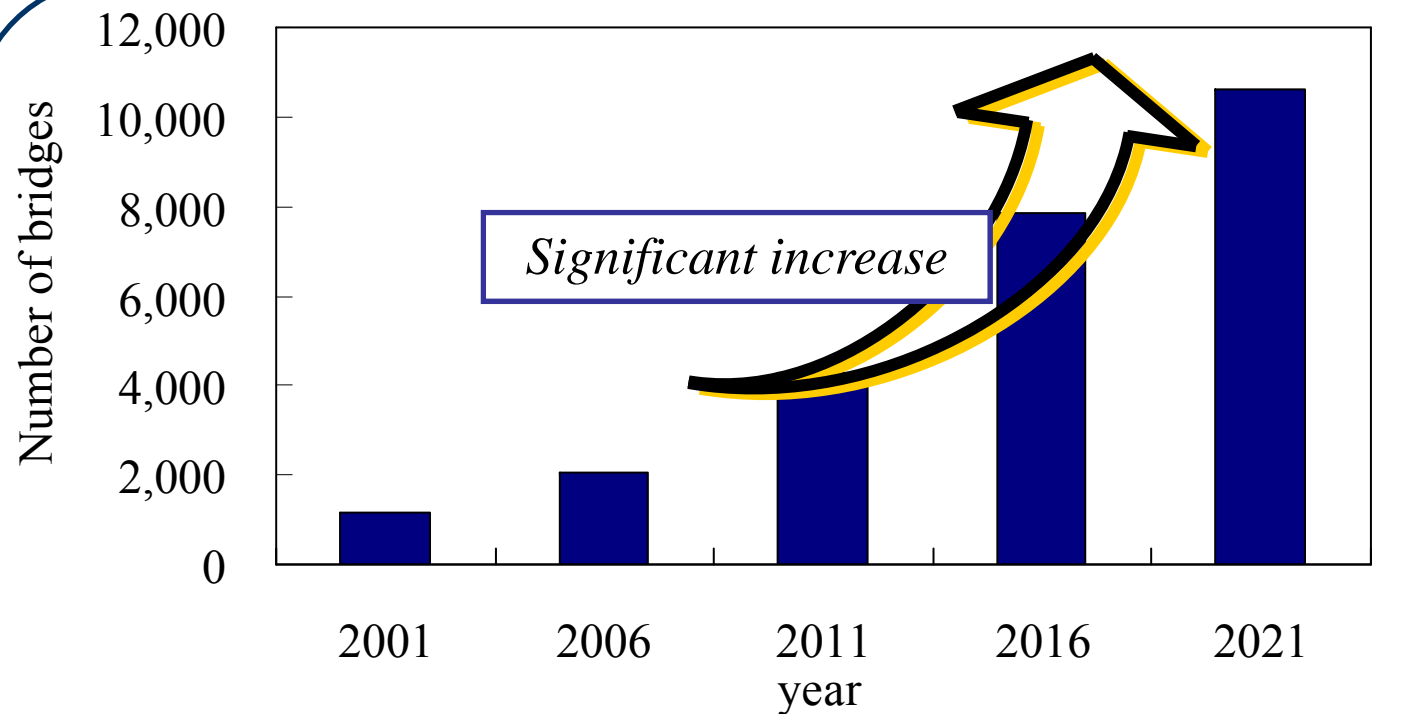
Durability of Steel Bridge Coating Systems Considering Acid Rain



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Background



Transition of the number of bridges over 50 years old in Japan

Significant increase of old steel bridges



It is important reducing the maintenance cost
Optimal Anticorrosive Coating system

Background (cont'd)

Anticorrosive coating systems

Paint coating systems : Widely used
Metallic coating systems : Newly developed

Optimum coating system for different environments



Evaluation of
corrosion resistance

Effect of acid rain on anticorrosive performance
not clear

Objective

Accelerated exposure tests for 300 days.

Salt water spray (5% salt water) Combined Cycle Test

compare

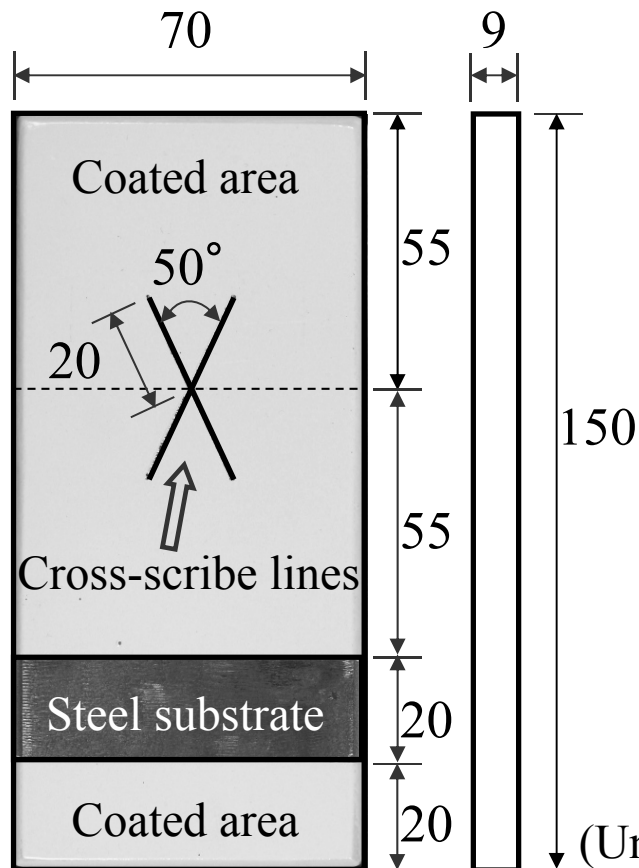
Acid rain spray (artificial acid rain, pH 3.5)

Investigate influence of acid rain
on anticorrosive performance of coating systems

Test Specimens

Chemical composition of the steel (%)

Material	C	Si	Mn	P	S
JIS G 3106 SM490A	0.17	0.34	1.43	0.046	0.004



Coating systems

A-paint system

C-paint system

I-paint system

Zinc hot-dip galvanizing

Zinc-aluminum alloys spraying

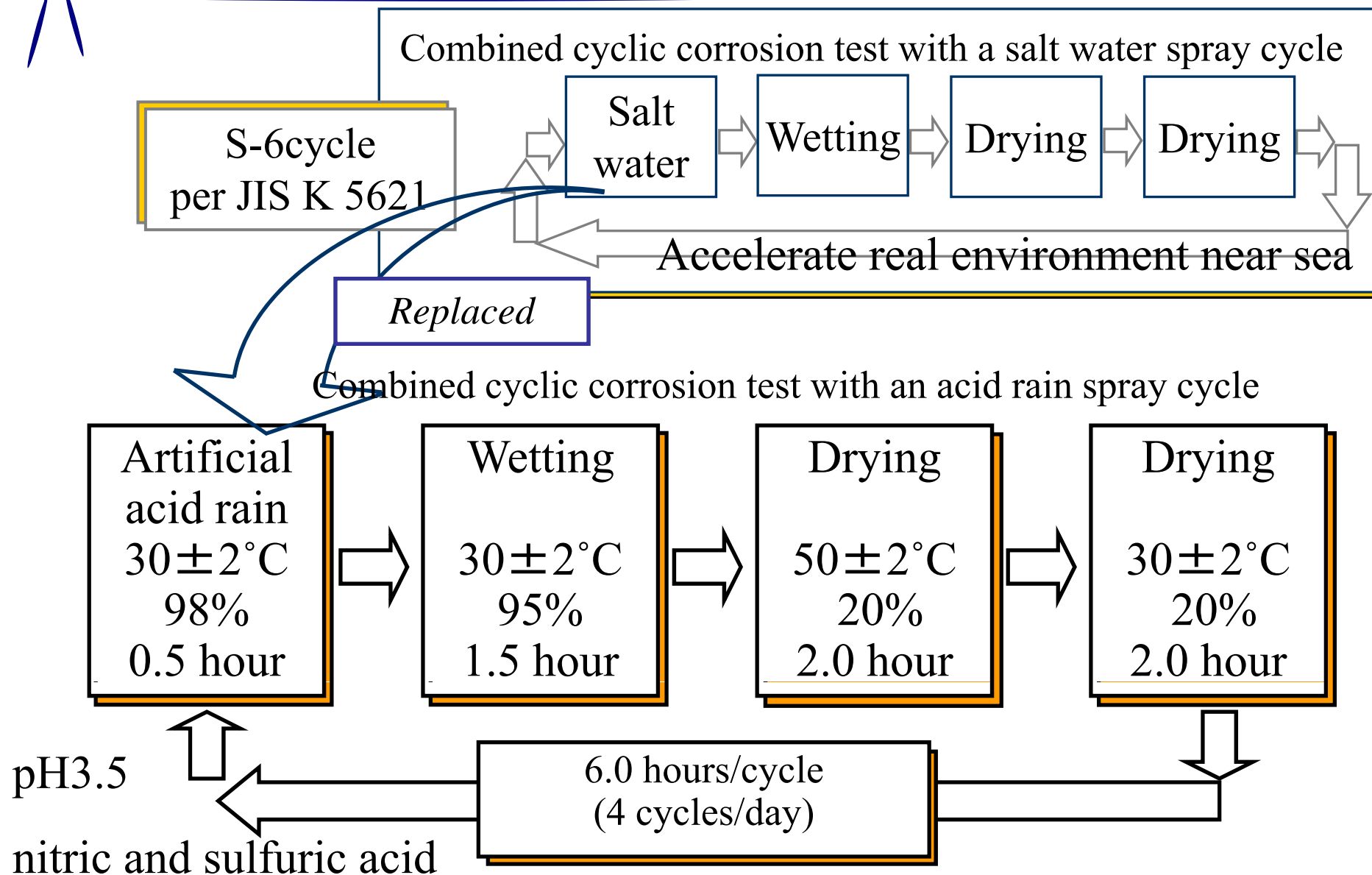
Zinc-aluminum pseudo-alloys spraying

Aluminum spraying

(Unit: mm)

12 specimens for each coating system

Accelerated Exposure Test



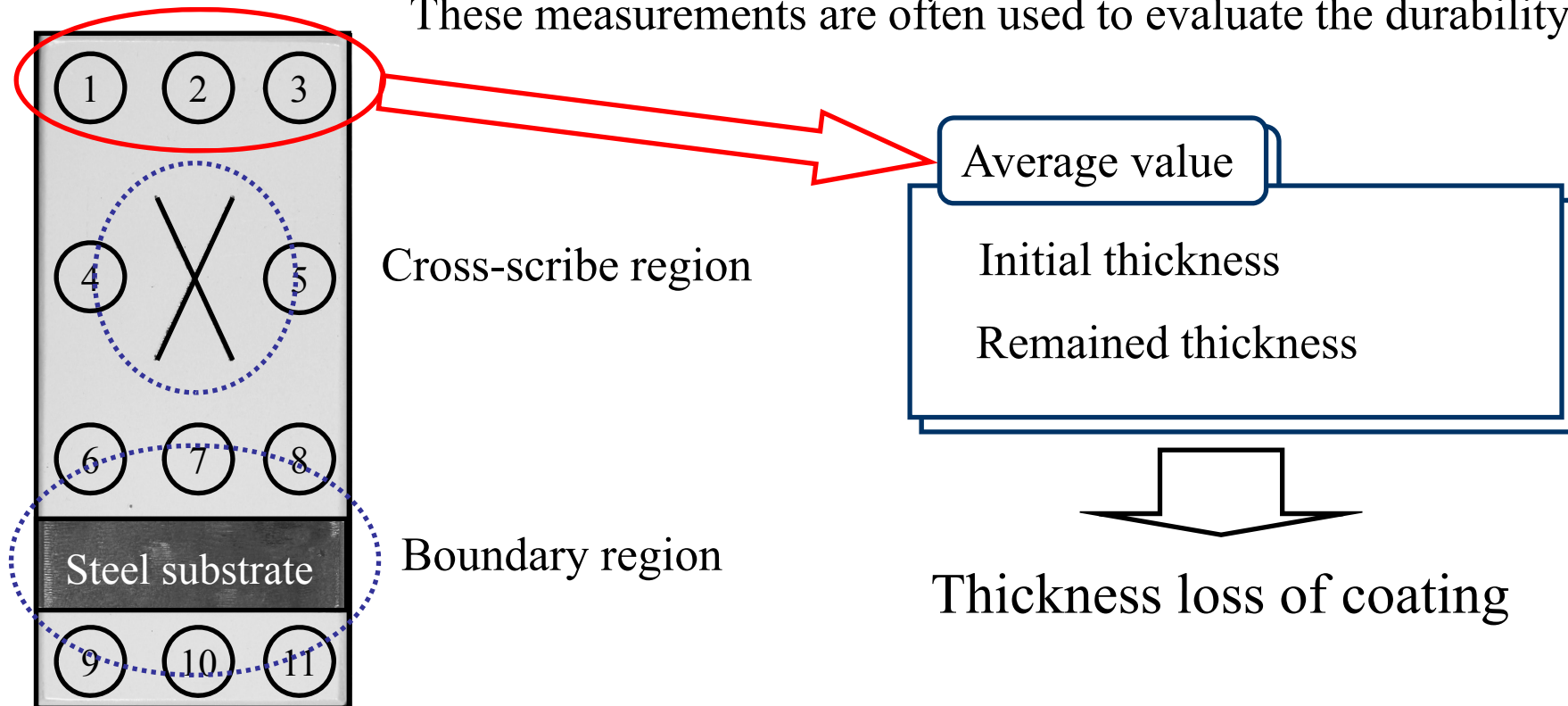
Performance measures

Three specimens for every 100days

Paint coating \Rightarrow Blistering area from cross-scribe line
Metallic coating \Rightarrow Thickness loss of coating

Measured by laser instrument

These measurements are often used to evaluate the durability

















Initial measured thickness of metallic coating

Initial measured thickness of metallic coating

Metallic coating		Thickness (μm)	
		Mean	Standard deviation
Acid rain spray combined cyclic test	zinc hot dip galvanizing	90.7	11.1
	zinc-aluminum alloy spraying	127.0	20.7
	zinc-aluminum pseudoalloy spraying	232.7	22.8
	aluminum spraying	131.4	27.2
Salt water spray combined cyclic test	zinc hot dip galvanizing	108.3	19.8
	zinc-aluminum alloy spraying	154.5	23.5
	zinc-aluminum pseudoalloy spraying	170.2	11.7
	aluminum spraying	172.4	36.7

Visual inspection

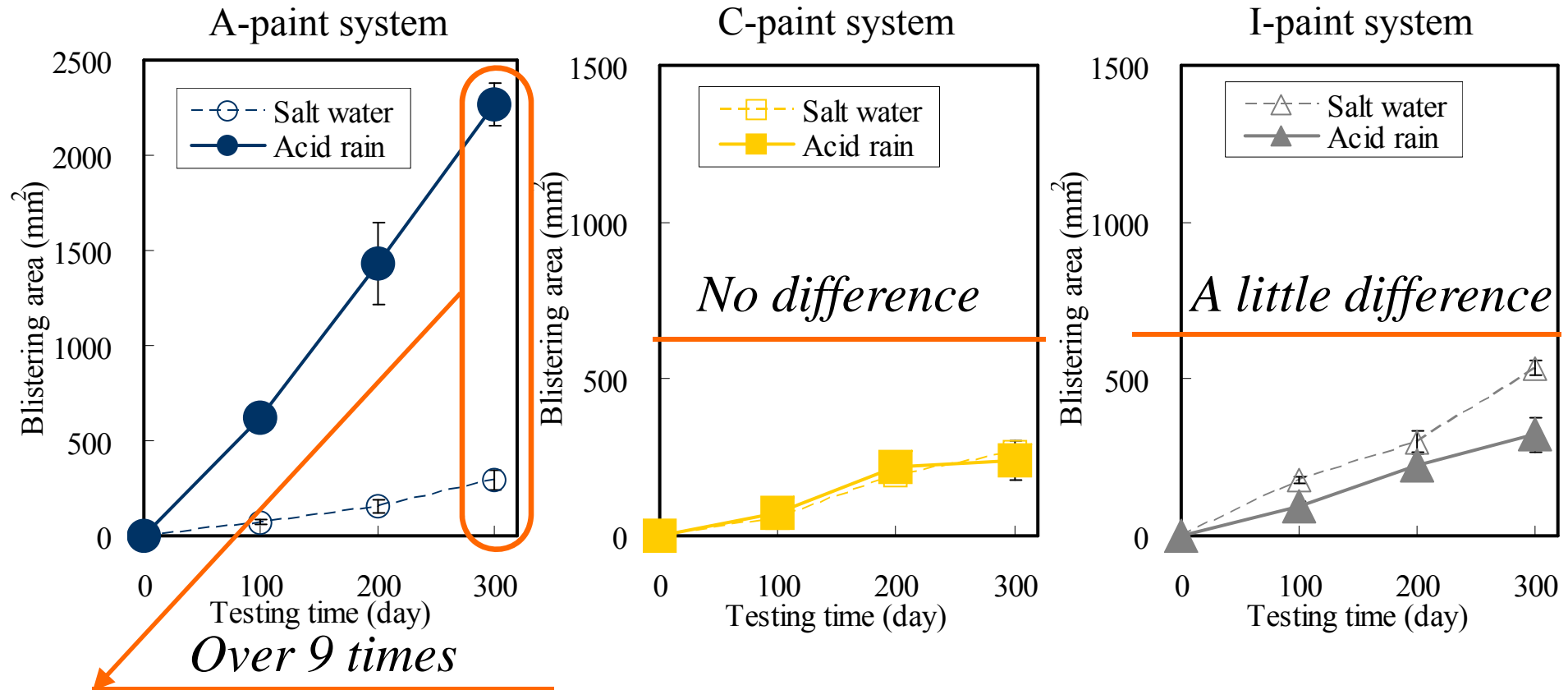
after 300 days of testing

	A-paint system	C-paint system	I-paint system	Zinc hot-dip galvanizing	Zinc-Aluminum alloys spraying	Zinc-aluminum pseudo-alloys spraying	Aluminum spraying
Acid rain spray combined cyclic test							
Salt water spray combined cyclic test							

Blistering area for paint coating system

Blistering area

Blister = rust under coating → Index for corrosion progress

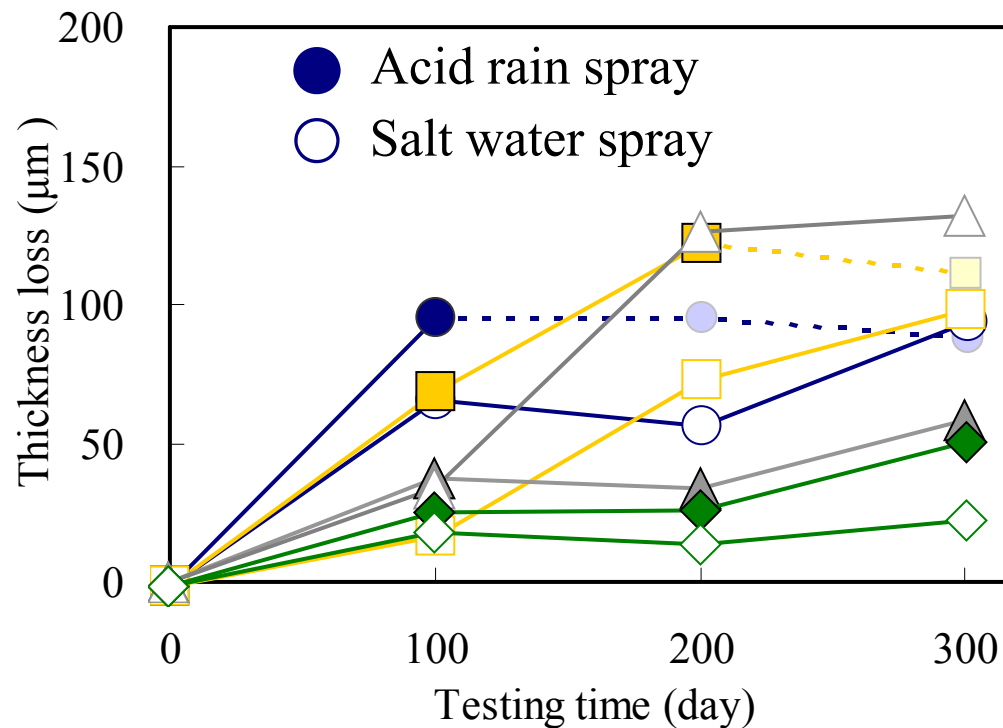


A-paint system was significantly affected by acid rain

Thickness loss for metallic coating system

Thickness loss

Thickness decrease sacrificially → Index for coating durability



Zinc hot dip galvanizing

Zinc-aluminum alloys


Zinc-aluminum pseudoalloys

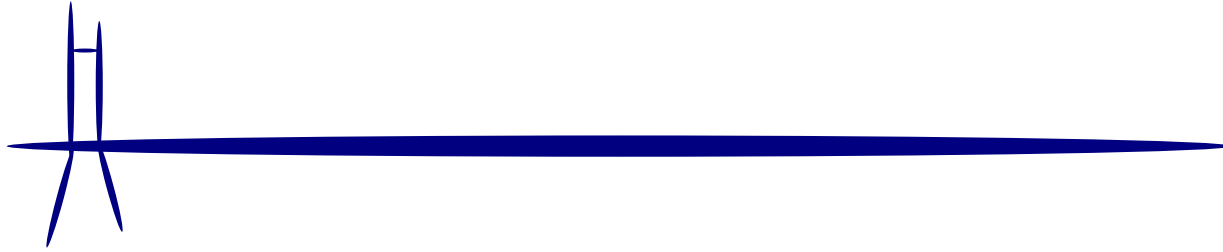
Aluminum spraying

Under acid rain environment larger thickness losses were found in

Zinc hot dip galvanizing
Zinc-aluminum alloys
Aluminum spraying

Conclusions

1. A-paint system can be significantly affected by acid rain.
 2. C- and I- paint systems have high anticorrosive performance against acid rain.
 3. Acid rain reduces durability of anticorrosive metallic coating systems of zinc hot dip galvanizing, zinc-aluminum alloy spraying and aluminum spraying.
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Thank you for your kind attention

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