中国五矿 | MCC 中冶建研院 ZHONGYEJIANYANYUAN

The 2nd international Belt and Road concrete technology symposium

Evaluating concrete permeability by bulk resistivity based on DC step input

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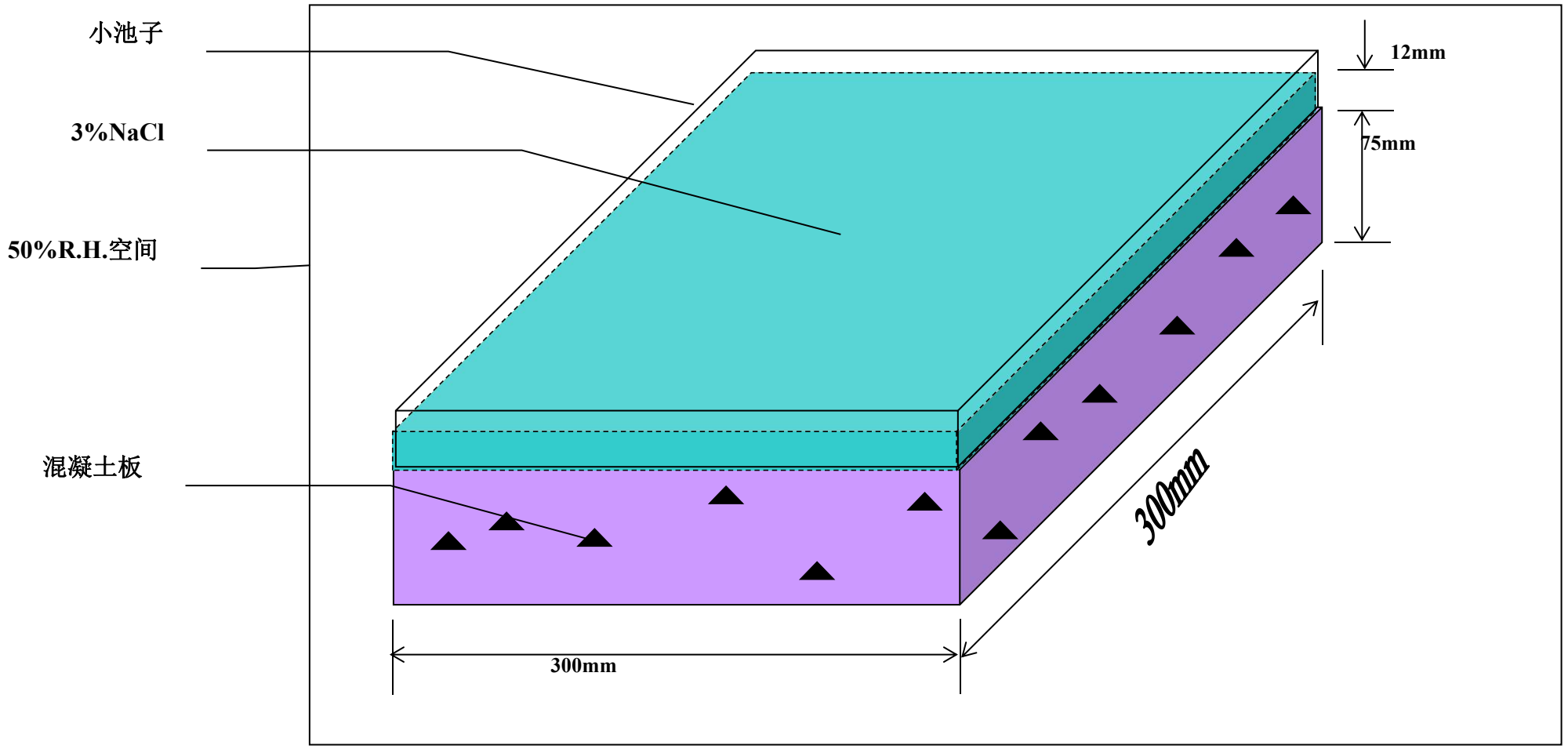
Contents

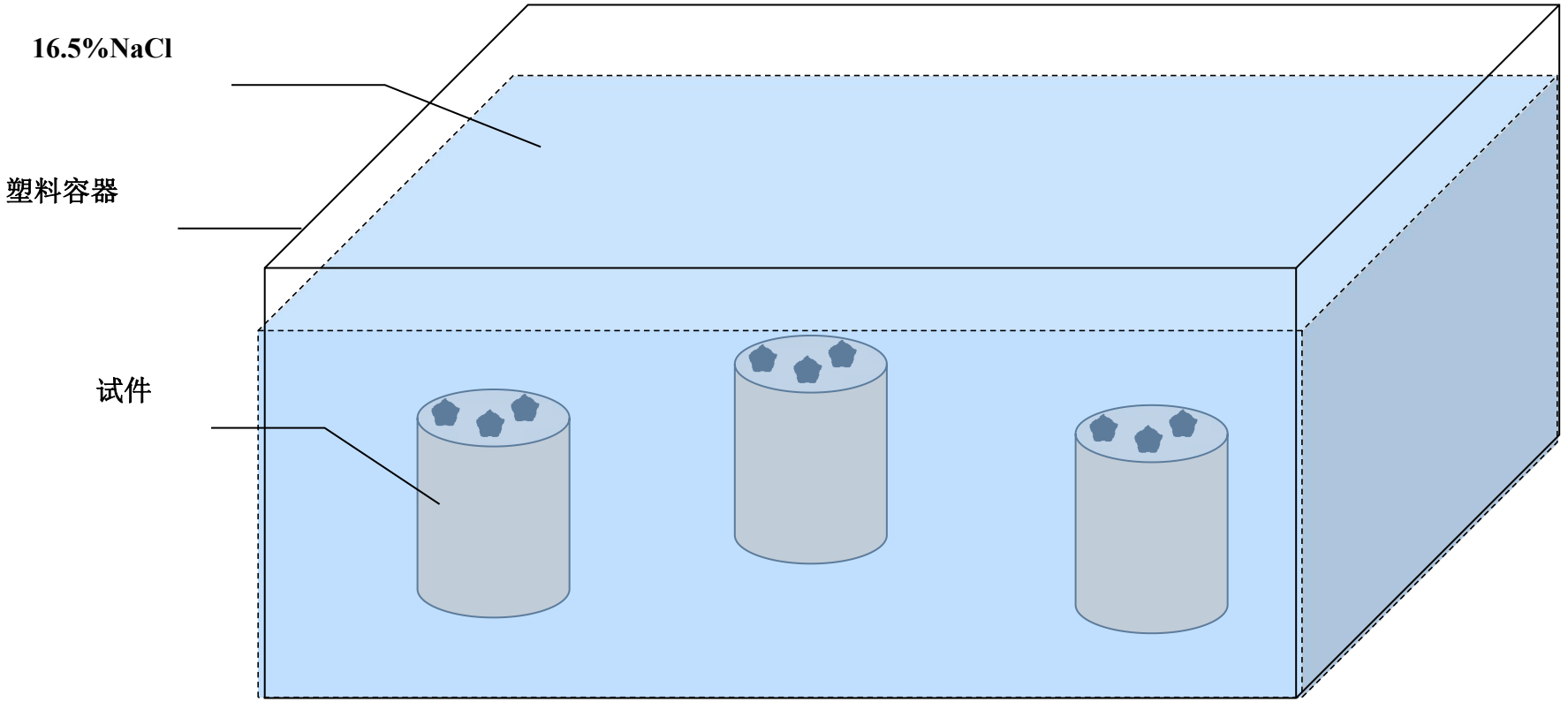
1、Introduction

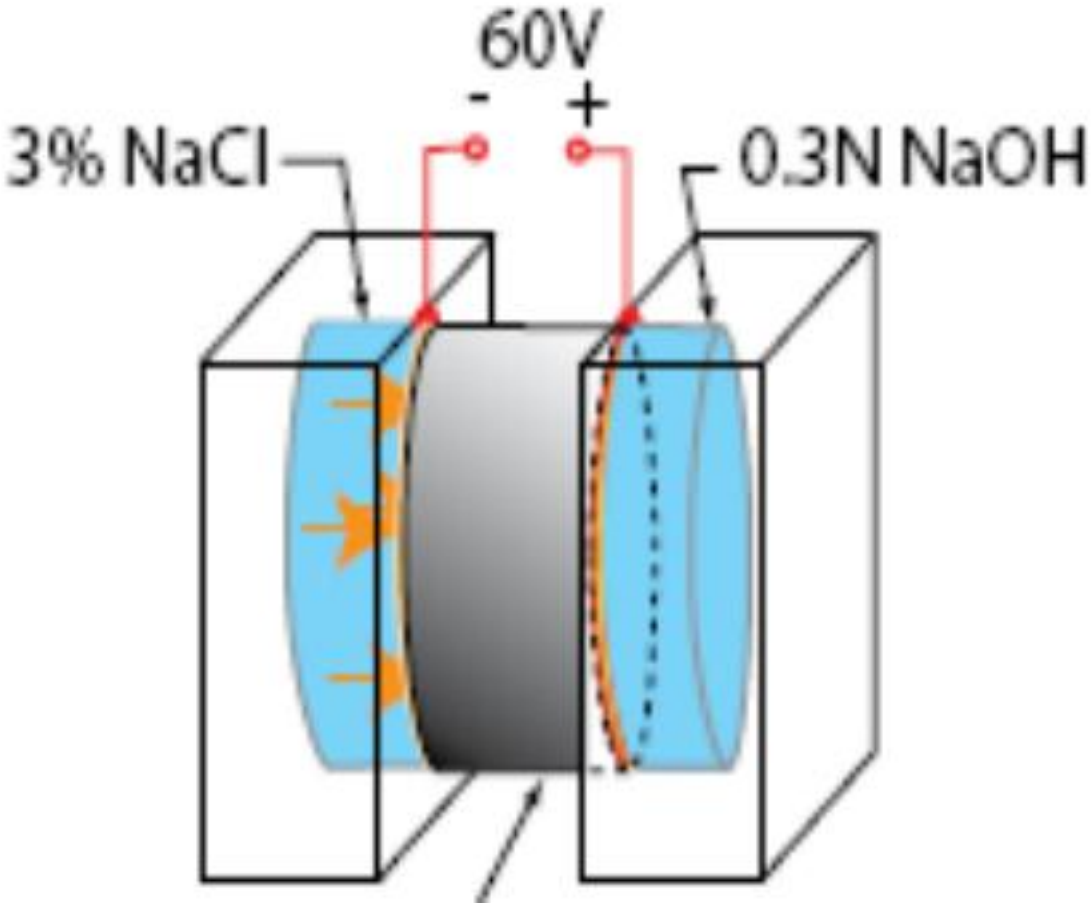
Permeability matters

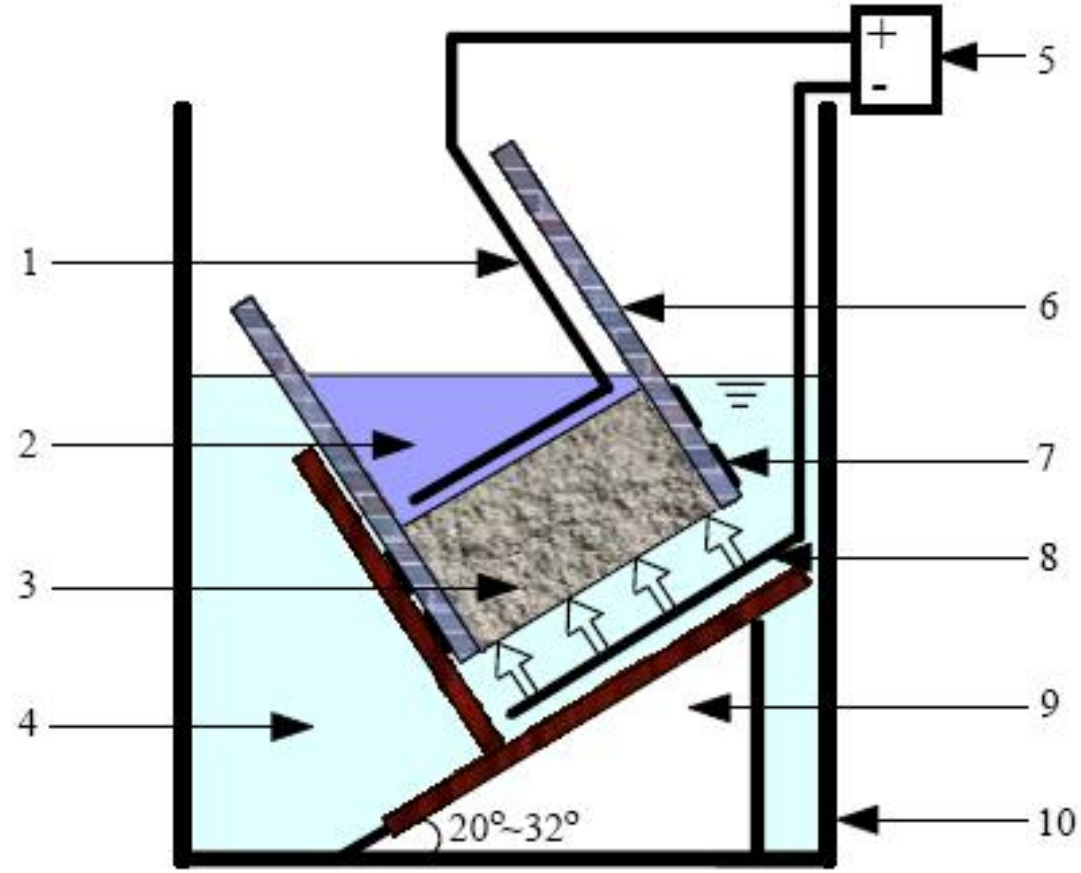
1. **Most deterioration process linked with permeability.**
2. **Water permeability is essential to concrete durability.**


自动加压混凝土渗透仪


小池子
3%NaCl
50%R.H.空间
混凝土板
12mm
75mm
300mm
300mm


16.5%NaCl
塑料容器
试件



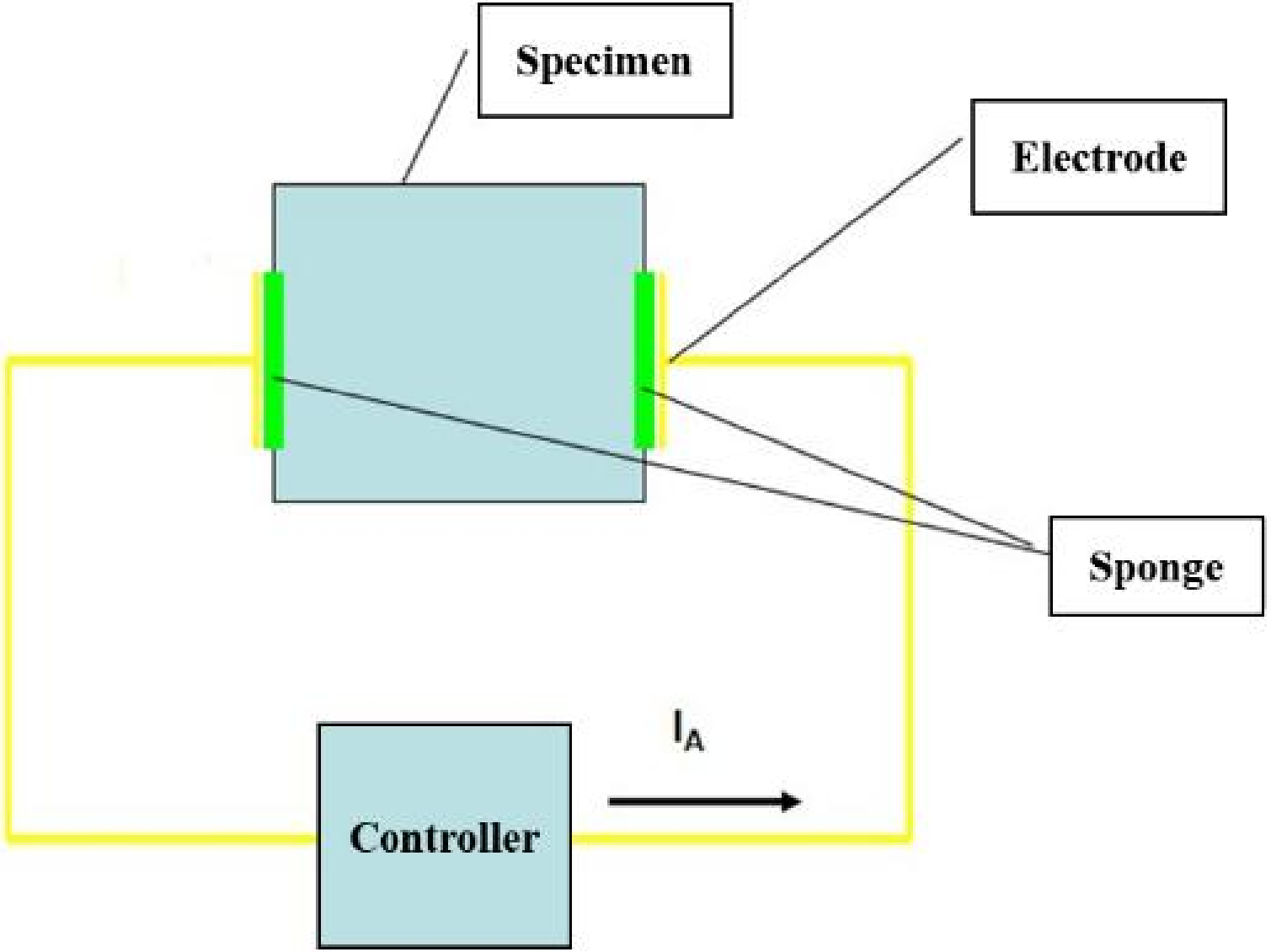


1—阳极；2—阳极溶液；3—试件；4—阴极溶液；5—直流稳压电源；
6—橡胶筒；7—环箍；8—阴极；9—支架；10—试验槽

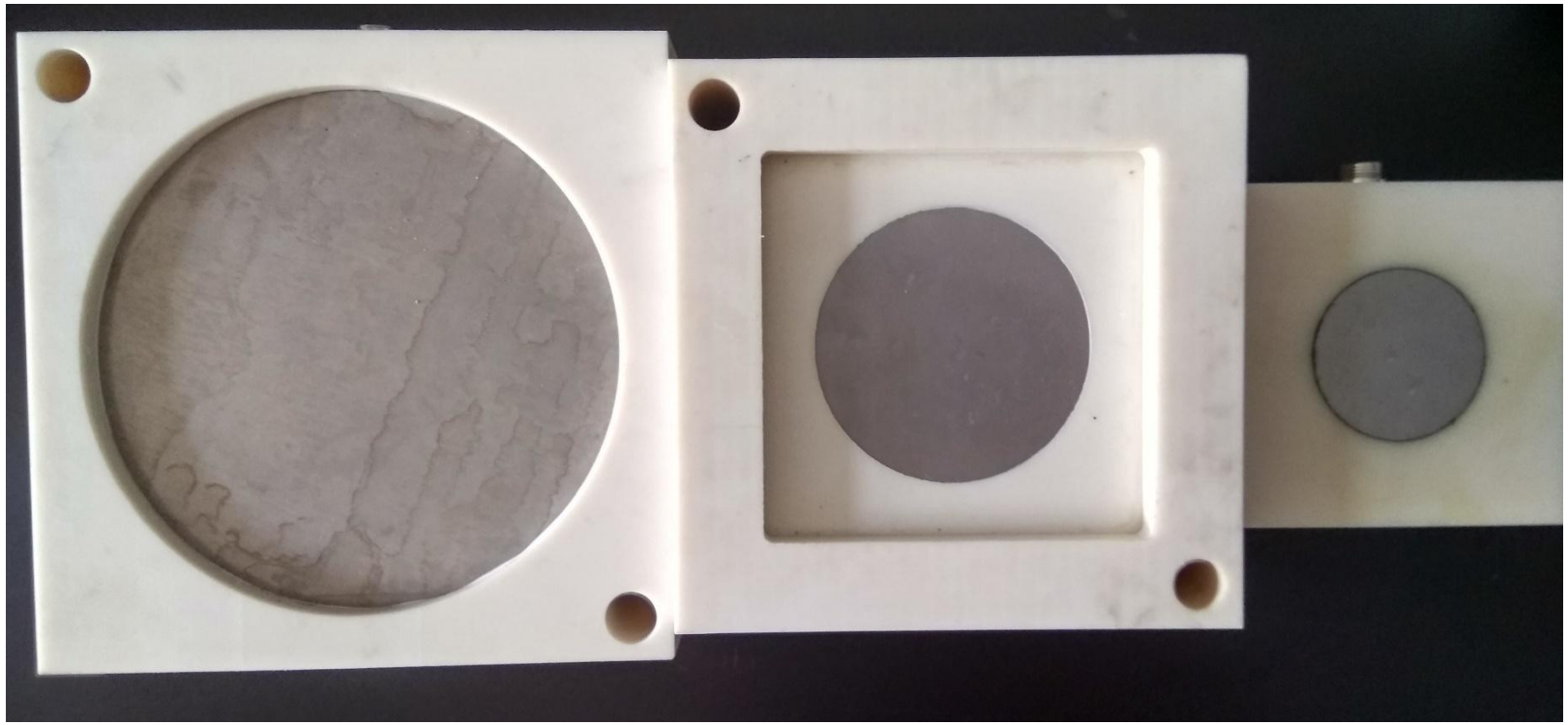
Problems

1. **Complex procedures**
2. **High cost**

2、Equipment bast on DC step input


Specimen
Electrode
Sponge
I_A
Controller

Select the size of electrode film



150mm 80mm 50mm

Main steps

1) start the device,direct current I_A is applied between the two electrode and the potential V_A is measured;
2) turn off the power in a very shot time and the switch potential is measured as V_B;
3) the initial current is 200 mA, decrease the current step to 0 by step of 20 mA;
4) change the current direction, increase the current from 0 to 200 mA;
5) calculate the bulk resistivity by the following formula:

$$\rho = \frac{(V_A - V_B) \bullet S}{I_A \bullet L}$$

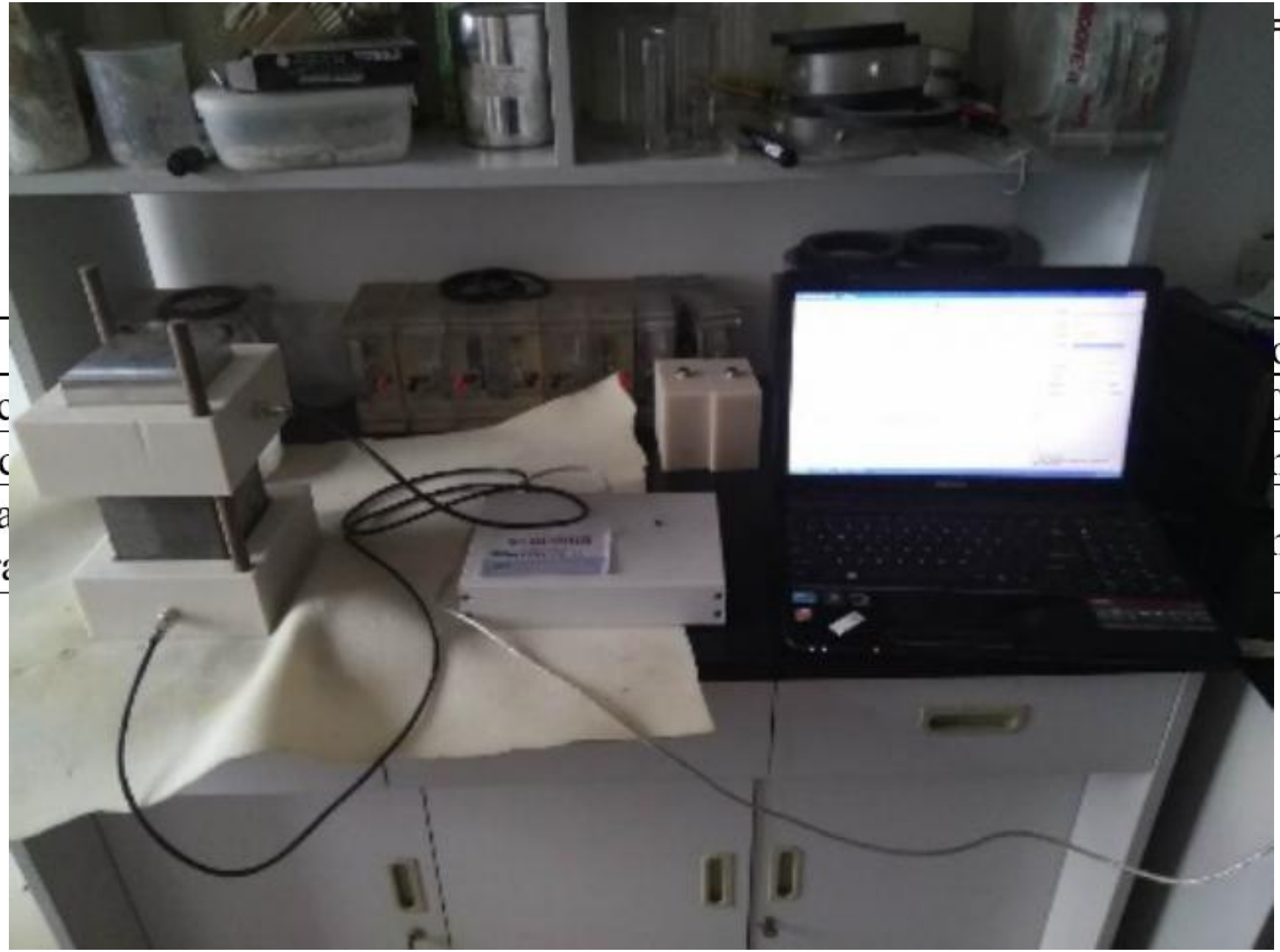
3、 Materials and methods

Materials

1. **Cement: P·O 42.5 cement**
2. **Fine aggregate: bulk density: 1540 kg/m^3**
3. **Coarse aggregate:bulk density: 1690 kg/m^3, void ratio: 45%,**
4. **Fly ash:fineness: 21.3%, water demand ratio: 102%.**
5. **GGBS:7-d activity: 91%, 28-day activity: 113%.**
6. **Polycarboxylate superplasticizer： 34%**

Number	Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse aggregate (kg/m^3)	Water (kg/m^3)	Sand ratio* (%)	Water-binder ratio	Fly ash (kg/m^3)	Slag (kg/m^3)	Water reducing agent content
WB-50	380	717	1075	190	40	0.5	/	/	/
WB-60	380	717	1075	228	40	0.6	/	/	/
WB-70	380	717	1075	266	40	0.7	/	/	/
SP-64	380	1147	645	152	64	0.4	/	/	2.1%
SP-60	380	1075	717	152	60	0.4	/	/	2.1%
SP-56	380	1004	788	152	56	0.4	/	/	2.1%
SP-52	380	933	859	152	52	0.4	/	/	2.1%
FA-00	380	717	1075	152	717	0.4	/	/	2.5%
FA-20	304	717	1075	152	717	0.4	76	/	2.5%
FA-40	228	717	1075	152	717	0.4	152	/	2.5%
FA-60	152	717	1075	152	717	0.4	228	/	2.5%
SL-00	380	717	1075	152	717	0.4	/	/	2.5%
SL-20	304	717	1075	152	717	0.4	/	76	2.5%
SL-40	228	717	1075	152	717	0.4	/	152	2.5%
SL-60	152	717	1075	152	717	0.4	/	228	2.5%

*sand ratio means the ratio of the fine aggregate mass to the total aggregate mass

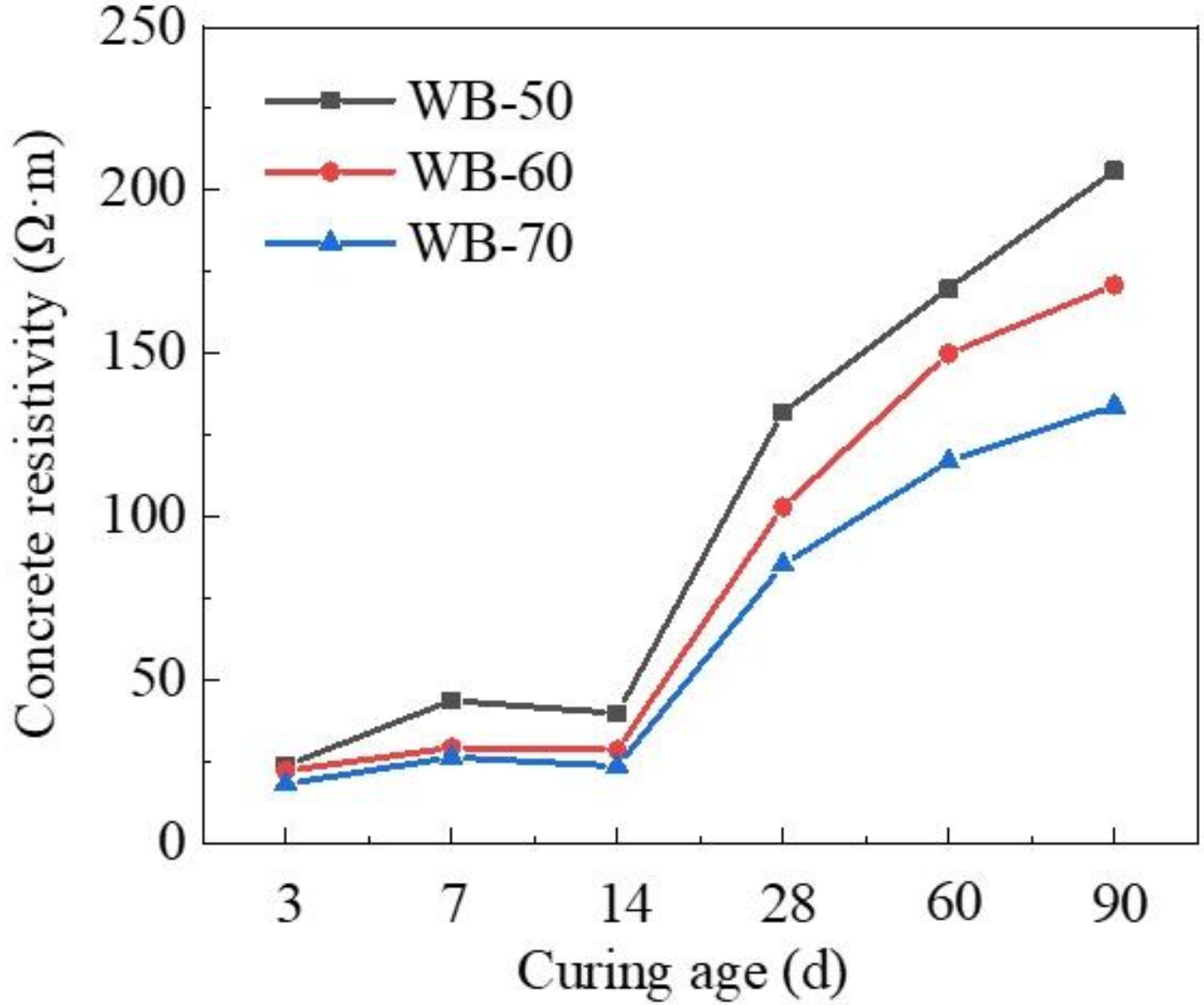


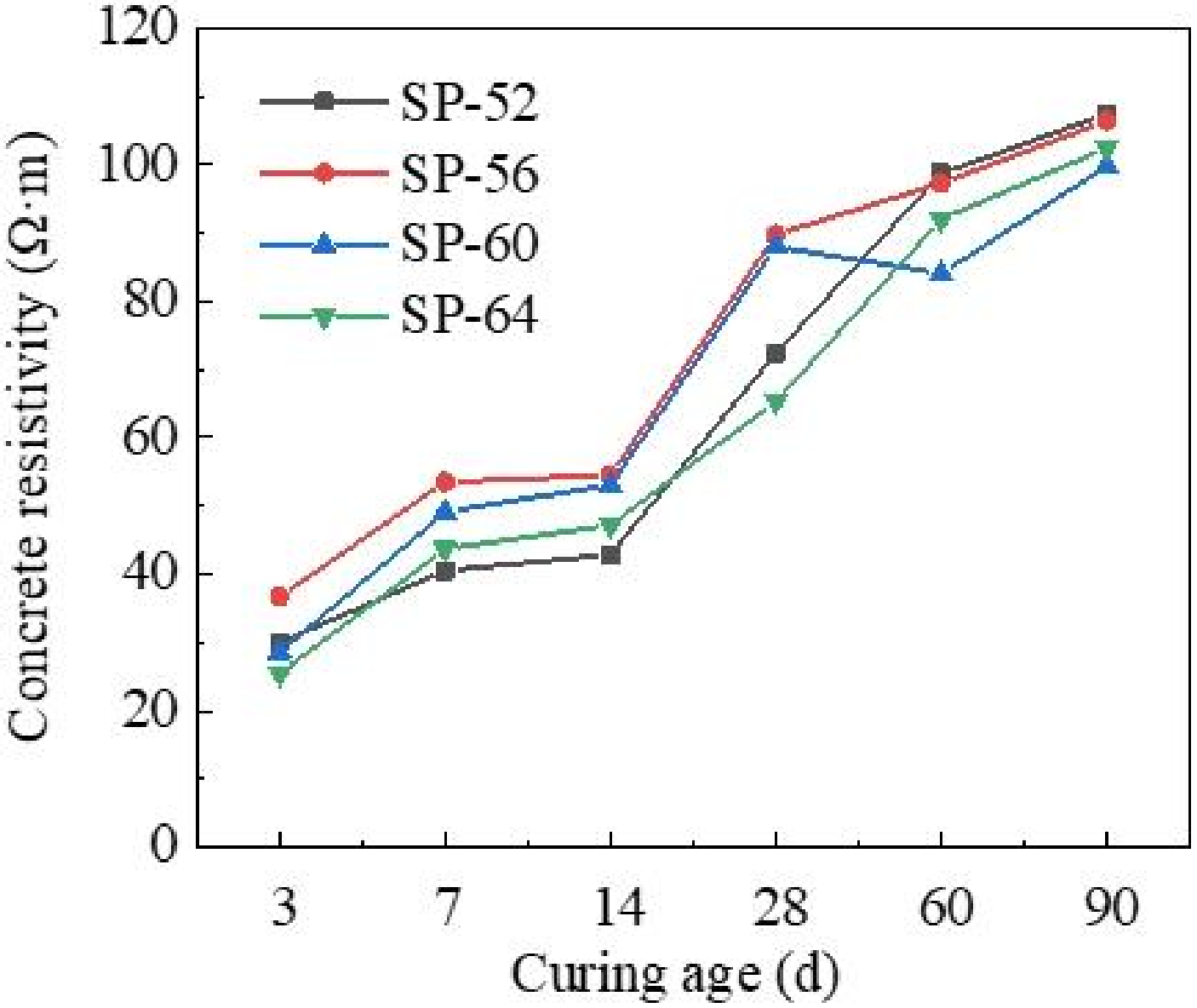
	of specimen
Conc	0 mm*100 mm
Electric	m *50 mm
Ra penetra	m *50 mm

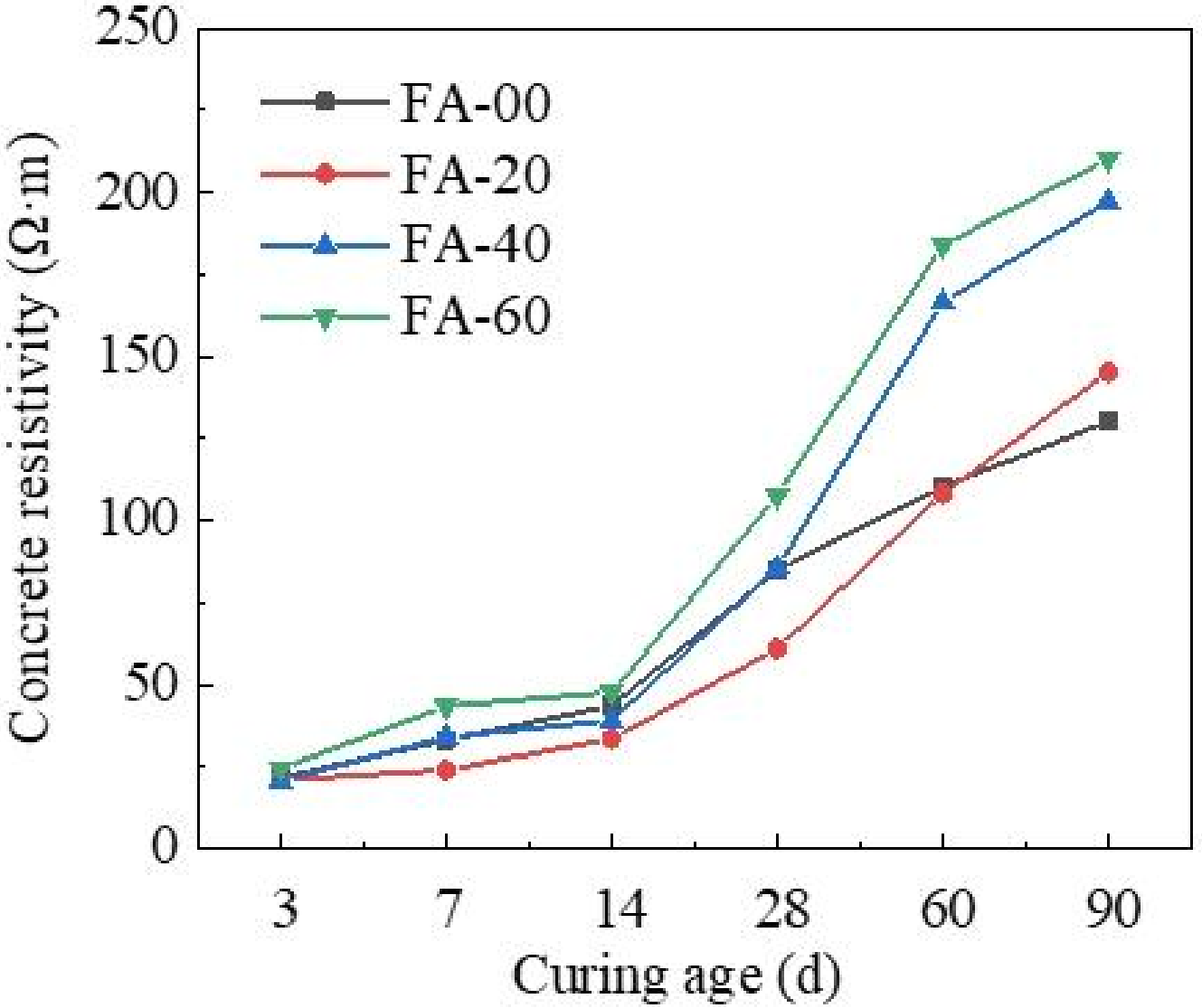
Experiments

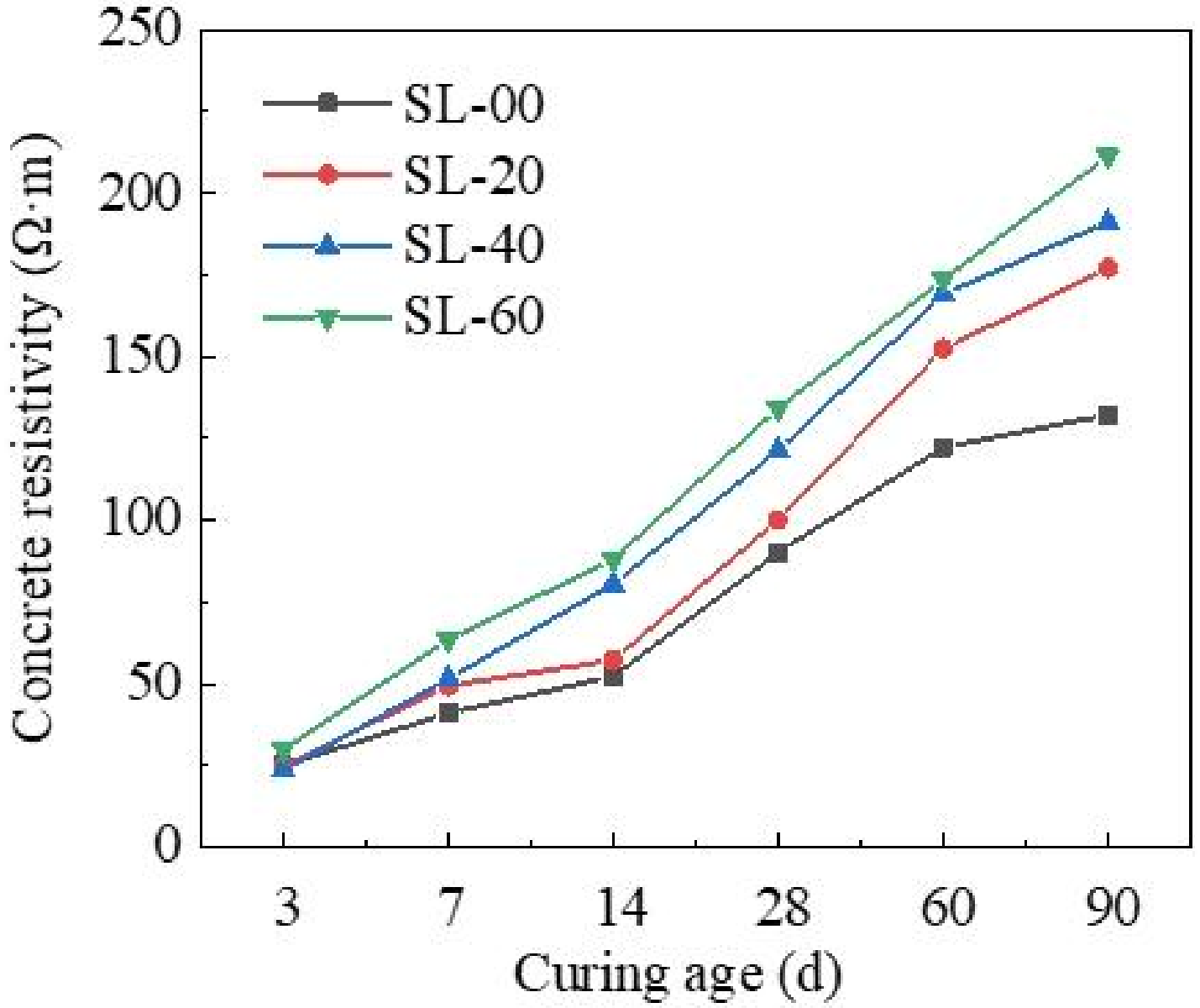
1) The influence of mixing ratio parameters (water-binder ratio, sand ratio and mineral admixture content) on concrete resistivity is studied by DCSI method, and the results are compared with those of other test methods;
2) Study the correlation between DCSI method, electricity flux method and rapid chloride migration (RCM) method to evaluate the permeability of concrete.

4、Influence of mix proportion

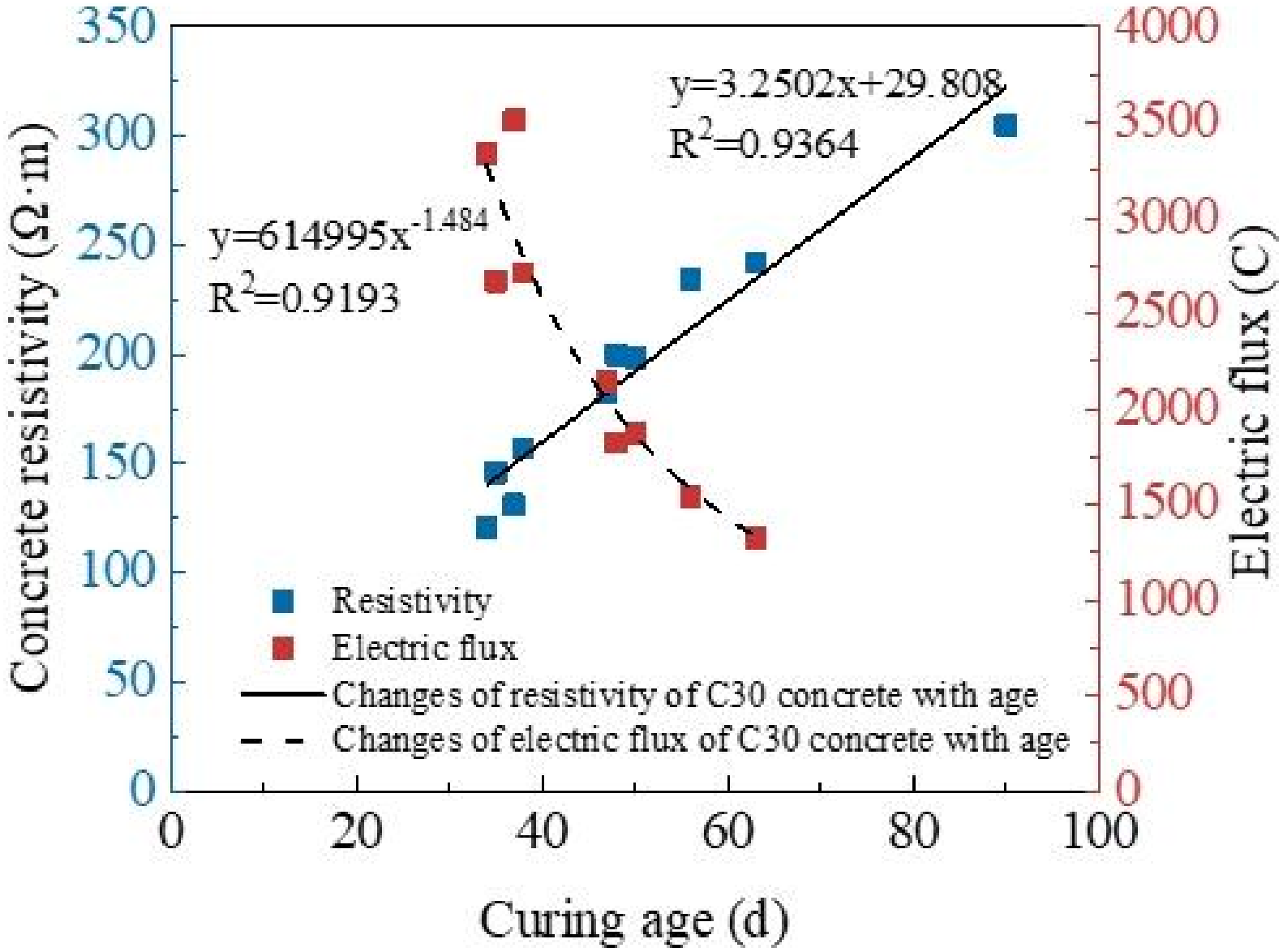

WB-50
WB-60
WB-70
Concrete resistivity (Ω·m)
250
200
150
100
50
0
3
7
14
28
60
90
Curing age (d)

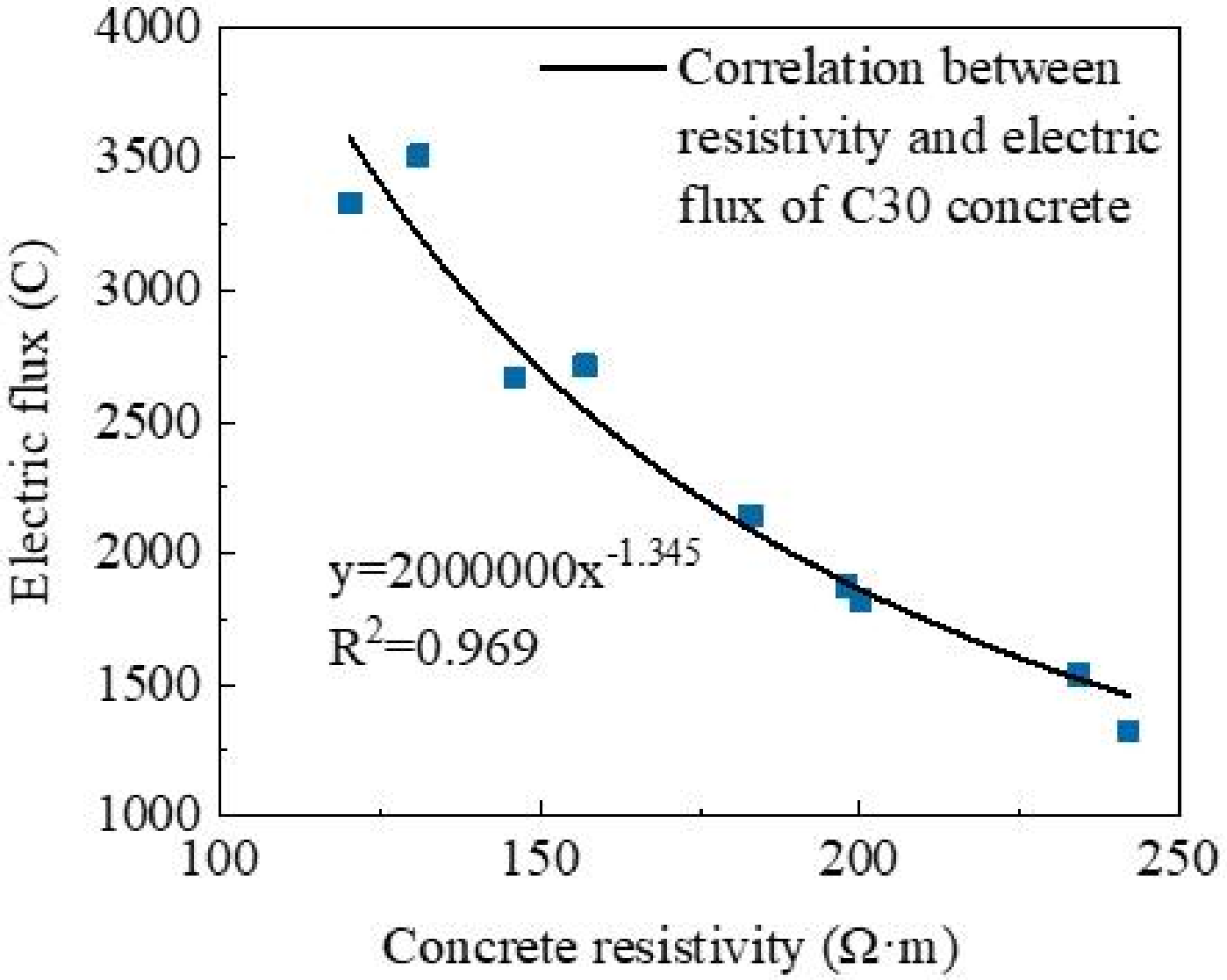

SP-52
SP-56
SP-60
SP-64
Concrete resistivity (Ω·m)
120
100
80
60
40
20
0
3
7
14
28
60
90
Curing age (d)

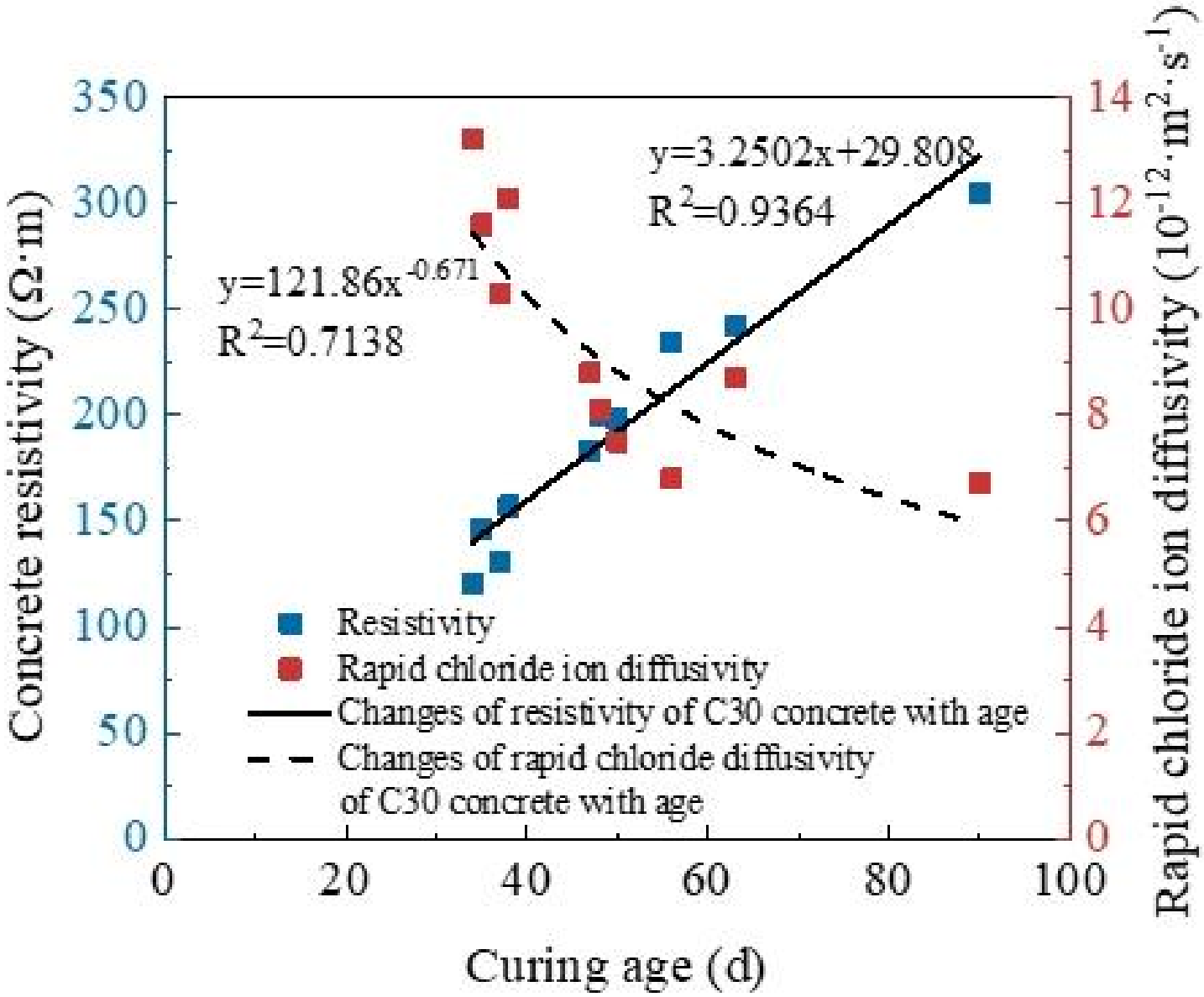

Concrete resistivity (Ω·m)
250
200
150
100
50
0
FA-00
FA-20
FA-40
FA-60
3
7
14
28
60
90
Curing age (d)

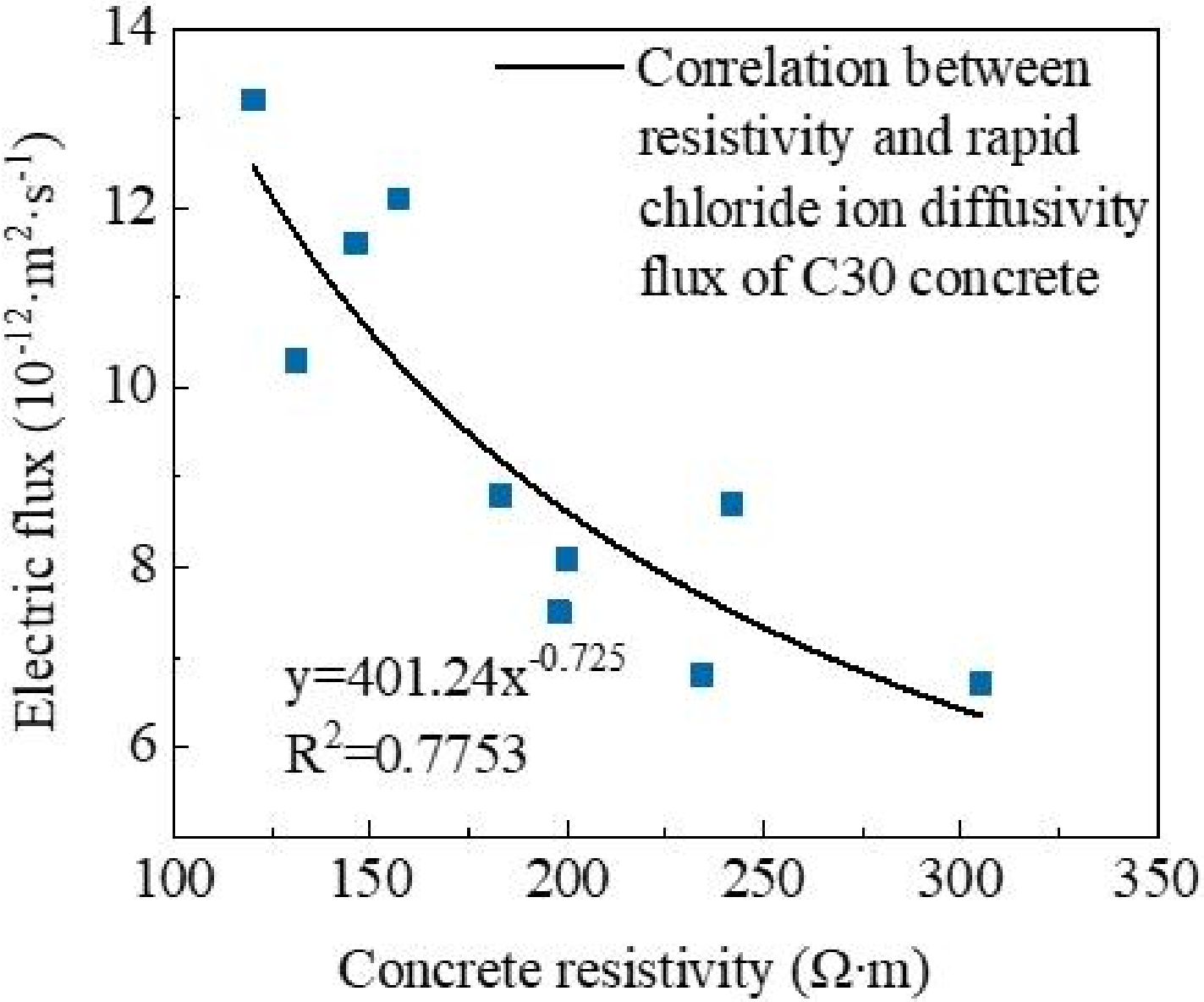

Concrete resistivity (Ω·m)
250
200
150
100
50
0
SL-00
SL-20
SL-40
SL-60
3
7
14
28
60
90
Curing age (d)

5、Evaluation of permeability of concrtete


y=3.2502x+29.808
R2=0.9364
y=614995x-1.484
R2=0.9193
Concrete resistivity (Ω·m)
Electric flux (C)
Curing age (d)
Resistivity
Electric flux
Changes of resistivity of C30 concrete with age
Changes of electric flux of C30 concrete with age
0
50
100
150
200
250
300
350
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100


Correlation between resistivity and electric flux of C30 concrete
y=2000000x^-1.345
R^2=0.969
Electric flux (C)
Concrete resistivity (Ω·m)
4000
3500
3000
2500
2000
1500
1000
100
150
200
250


y=3.2502x+29.808
R²=0.9364
y=121.86x^-0.671
R²=0.7138
Resistivity
Rapid chloride ion diffusivity
Changes of resistivity of C30 concrete with age
Changes of rapid chloride diffusivity of C30 concrete with age
Concrete resistivity (Ω·m)
Rapid chloride ion diffusivity (10^-12·m^2·s^-1)
Curing age (d)
0
50
100
150
200
250
300
350
0
2
4
6
8
10
12
14
0
20
40
60
80
100


Correlation between resistivity and rapid chloride ion diffusivity flux of C30 concrete
y=401.24x^-0.725
R^2=0.7753
Electric flux (10^-12·m^2·s^-1)
Concrete resistivity (Ω·m)
14
12
10
8
6
100
150
200
250
300
350

6、Conclusions

conclusions

1. The DCSI method can quickly detect the electrical resistivity of concrete by testing cubic compressive strength specimens after standard curing in a few minutes, without need of extra cylinder specimens.
2. The water-cement ratio, kinds of mineral admixtures and its content influence the electrical resistivity significantly while the sand rate has no obvious effect.

conclusions

3. The correlation between resistivity and electric flux and rapid chloride ion diffusion coefficient is tested using C30 concrete produced by a ready-mixed concrete company in Beijing, and the correlation coefficients reached 0.969 and 0.775 respectively.

It is tentatively demonstrated that the resistivity method proposed in this study could replace the electric flux method in the laboratory to evaluate the chloride ion penetration resistance of concrete.

河北雄安新区管理委员会改革发展局

河北雄安新区管理委员会改革发展局关于发布《雄安新区电力用户用电导则》等六项雄安新区地方标准的通告

2023 年第 4 号

河北雄安新区管理委员会改革发展局组织制定了《雄安新区电力用户用电导则》等 2 项雄安新区地方标准，会同河北雄安新区管理委员会建设和交通管理局联合发布了《雄安新区高性能混凝土应用技术规程》等 2 项雄安新区地方标准，会同河北雄安新区管理委员会公共服务局联合发布了《农村人居环境整治效果评价指标体系》等 2 项雄安新区地方标准，现予以通告（详细目录见附件）。

本通告可通过中国雄安官网（www.xiongan.gov.cn）“政务信息”中进行查询，标准文本可从标准图书馆网站（http://www.bzsb.info）中下载。

附件：批准发布的雄安新区地方标准目录

河北雄安新区管理委员会改革发展局

2023 年 8 月 11 日

ICS 91.100.30
Q 13

DB1331

雄 安 新 区 地 方 标 准

DB1331/T 049 - 2023

雄安新区高性能混凝土应用技术规程

Technical specification for application of high performance concrete in Xiong'an

2023-08-11 发布　　2023-08-15 实施

河北雄安新区管理委员会建设和交通管理局
河北雄安新区管理委员会改革发展局　发布

Questions?