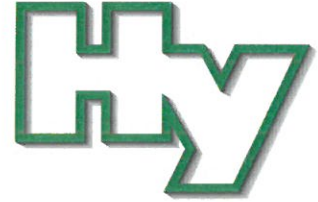


Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Toxikologie

Direktor: Prof. Dr. rer. nat. L. Dunemann

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V.



Hygiene-Institut · Postfach 10 12 55 · 45812 Gelsenkirchen

Hyosung Corporation
Mr. Jeong Sung Chung
119, Mapo-daero, Mapo-gu
SEOUL
REPUBLIC OF KOREA

Visitors/ postal address:

Rotthauser Str. 21, 45879 Gelsenkirchen,
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Phone (0049209) 9242-230
Fax (0049209) 9242-222
E-Mail c.schell@hyg.de
Internet www.hyg.de

Reference: W-294066ae-18-SI/to
Contact person: Mrs. Dr. Ch. Schell

Gelsenkirchen, 20.02.2018

Test according to DVGW Technical Standard W 270 of various materials

Your order dated 17.07.2017

Dear Mr. Chung,

please find enclosed the test reports and the combined test certificate **W-294066e-18-SI/to** for the following materials:

- **POKETONE M730F (W-294066e-18-SI)**
- **POKETONE M330F (W-294067e-18-SI)**
- **POKETONE M930F (W-294068e-18-SI)**

Attached is also the appropriate invoice.

Best regards

The Director of the Institute

p.p.

Dr. Ch. Schell

Head of Laboratory

Department of Water Hygiene and Environmental Microbiology

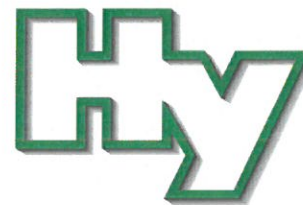
Enclosure

Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Toxikologie

Direktor: Prof. Dr. rer. nat. L. Dunemann

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V.



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E-Mail c.schell@hyg.de
Internet www.hyg.de

Reference: W-294066e-18-SI/to
Contact person: Mrs. Dr. Ch. Schell

Gelsenkirchen, 17.01.2018

TEST REPORT

Enhancement of Microbial Growth on Materials to Come into Contact with Drinking water
Test pursuant to DVGW Technical Standard W 270, November 2007

Client: Hyosung Corporation
119, Mapo-daero, Mapo-gu
SEOUL
REPUBLIC OF KOREA

Ordering date: 17.07.2017

Description of the material:

Test material:	POKETONE M730F
Composition:	recipe submitted and checked (7352)
Processing instructions:	for specifications, consult the client
Field of application:	for specifications, consult the client
Quantity of material per area unit:	for specifications, consult the client

Test samples:

Nature and property:	25 plates of hard plastics yellow-beige, 12.5 cm x 12.5 cm x 0.3 cm
Manufacturing:	carried out by the client (description submitted)
Processing conditions:	carried out by the client (description submitted)

Date of receipt of test samples: 27.07.2017

Storing conditions in the testing laboratory until start of test: at room temperature

This test report consists of 3 pages.

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Deutsche
Akkreditierungsstelle
D-PL-13042-02-00

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V., Vereinsregister: VR 519 Amtsgericht Gelsenkirchen, USt-ID: DE125018356
Vorstand: Prof. Dr. Werner Schlake (Vors.), Prof. Dr. Jürgen Kretschmann, Dr. Emanuel Grün, Dr. Dirk Waider, Prof. Dr. Lothar Dunemann (geschäftsführ. Vorstand)

Test conditions:

The tests were performed in accordance with the recommendations contained in DVGW Technical Standard W 270 as of November 2007. Details regarding testing procedures, as well as testing conditions will be given in said Technical Standard. The surface of the examined test pieces totals to approx. 930 cm² each. Using six test items per test period the following test scheme was applied:

- monthly sampling of surface biomass (test period 3 months altogether)
- sampling after 2 months (test period 2 months altogether)
- sampling after 3 months (test period 3 months altogether)

Prior to testing, the test specimens were placed in running tap water for 20 hours, followed by a disinfection procedure using 1% chlorine bleach for 30 ± 5 minutes and then rinsed with drinking water.

Time of exposure:

1-month samples	1a:	1 st	test period from 18.10.2017 to 15.11.2017
	1b:	2 nd	test period from 15.11.2017 to 12.12.2017
	1c:	3 rd	test period from 12.12.2017 to 09.01.2018
2-month samples	2a:	1 st	test period from 18.10.2017 to 12.12.2017
3-month samples	3a:	1 st	test period from 10.10.2017 to 09.01.2018

The exposure took place in containers filled with ground water of drinking water quality at a continuous flow rate of approx. 20 l/h over a period of three months. The water temperature ranged from 8.9°C to 9.3°C.

After one, two and three months the surfaces of the test pieces, as well as the corresponding negative reference samples (stainless steel) and positive reference samples (paraffin) were scraped clean in order to examine for biofilm formation. Afterwards, the surface biomass was transferred to suitable centrifuge tubes. The subsequent centrifugation was carried out at 3.000 x g for 10 minutes followed by the determination of the volume of the sediment.

Test results:

The positive reference sample (pK) showed a pronounced formation of biofilm during all test periods. There was no formation of surface biomass on the negative reference sample (nK).

The results of the analyses of the single specimens of approx. 930 cm² surface in total, pursuant to DVGW Technical Standard W 270 were as follows:

Volume of surface biomass

(single values and arithmetic mean of 6 test pieces, given in ml / referring to 800 cm²)

Start of test: 18.10.2017		1-month values		2-month values		3-month values
18.10.2017 – 15.11.2017	1a nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5	2a	(< 0.01/< 0.01) - < 0.01 > 1.5		
15.11.2017 – 12.12.2017	1b nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5	nK pK		3a nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5
12.12.2017 – 09.01.2018	1c nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5				

Limiting values [ml / 800 cm²] pursuant to DVGW Technical Standard W 270 (11/2007)

General application: arithmetic means	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)
Large surface seals (D 1): arithmetic means	≤ (0.12 + 0.03) whereas 1c ≤ 1b	≤ (0.12 + 0.03)	≤ (0.12 + 0.03) whereas 3a ≤ 2a
Small surface seals (D 2): arithmetic means	≤ (0.20 + 0.03) whereas 1c ≤ 1b	≤ (0.20 + 0.03)	≤ (0.20 + 0.03) whereas 3a ≤ 2a
Negative Control:	< 0.01 ml	< 0.01 ml	< 0.01 ml
Positive Control:	≥ 1.5 ml	≥ 1.5 ml	≥ 1.5 ml

Assessment:

Provided that it is applied correctly, the material

POKETONE M730F

is suitable for the use in drinking water systems according to the results of the microbiological examinations pursuant to DVGW Technical Standard W 270 (11/2007).

The Director of the Institute

p.p.

Dr. Ch. Schell

Head of Laboratory

Department of Water Hygiene and Environmental Microbiology

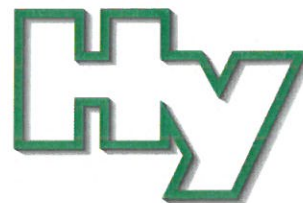


Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Toxikologie

Direktor: Prof. Dr. rer. nat. L. Dunemann

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V.



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Internet www.hyg.de

Reference: W-294067e-18-SI/to
Contact person: Mrs. Dr. Ch. Schell

Gelsenkirchen, 17.01.2018

TEST REPORT

Enhancement of Microbial Growth on Materials to Come into Contact with Drinking water
Test pursuant to DVGW Technical Standard W 270, November 2007

Client:

Hyosung Corporation
119, Mapo-daero, Mapo-gu
SEOUL
REPUBLIC OF KOREA

Ordering date:

17.07.2017

Description of the material:

Test material:	POKETONE M330F
Composition:	recipe submitted and checked (7352)
Processing instructions:	for specifications, consult the client
Field of application:	for specifications, consult the client
Quantity of material per area unit:	for specifications, consult the client

Test samples:

Nature and property:	25 plates of hard plastics yellow-beige, 12.5 cm x 12.5 cm x 0.3 cm
Manufacturing:	carried out by the client (description submitted)
Processing conditions:	carried out by the client (description submitted)

Date of receipt of test samples:

27.07.2017

Storing conditions in the testing laboratory until start of test: at room temperature

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Deutsche
Akkreditierungsstelle
D-PL-13042-02-00

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V., Vereinsregister: VR 519 Amtsgericht Gelsenkirchen, USt.-ID: DE125018356
Vorstand: Prof. Dr. Werner Schlake (Vors.), Prof. Dr. Jürgen Kretschmann, Dr. Emanuel Grün, Dr. Dirk Waider, Prof. Dr. Lothar Dunemann (geschäftsführ. Vorstand)

Test conditions:

The tests were performed in accordance with the recommendations contained in DVGW Technical Standard W 270 as of November 2007. Details regarding testing procedures, as well as testing conditions will be given in said Technical Standard. The surface of the examined test pieces totals to approx. 930 cm² each. Using six test items per test period the following test scheme was applied:

- monthly sampling of surface biomass (test period 3 months altogether)
- sampling after 2 months (test period 2 months altogether)
- sampling after 3 months (test period 3 months altogether)

Prior to testing, the test specimens were placed in running tap water for 20 hours, followed by a disinfection procedure using 1% chlorine bleach for 30 ± 5 minutes and then rinsed with drinking water.

Time of exposure:

1-month samples	1a:	1 st	test period from 18.10.2017 to 15.11.2017
	1b:	2 nd	test period from 15.11.2017 to 12.12.2017
	1c:	3 rd	test period from 12.12.2017 to 09.01.2018
2-month samples	2a:	1 st	test period from 18.10.2017 to 12.12.2017
3-month samples	3a:	1 st	test period from 10.10.2017 to 09.01.2018

The exposure took place in containers filled with ground water of drinking water quality at a continuous flow rate of approx. 20 l/h over a period of three months. The water temperature ranged from 8.9°C to 9.3°C.

After one, two and three months the surfaces of the test pieces, as well as the corresponding negative reference samples (stainless steel) and positive reference samples (paraffin) were scraped clean in order to examine for biofilm formation. Afterwards, the surface biomass was transferred to suitable centrifuge tubes. The subsequent centrifugation was carried out at 3.000 x g for 10 minutes followed by the determination of the volume of the sediment.

Test results:

The positive reference sample (pK) showed a pronounced formation of biofilm during all test periods. There was no formation of surface biomass on the negative reference sample (nK).

The results of the analyses of the single specimens of approx. 930 cm² surface in total, pursuant to DVGW Technical Standard W 270 were as follows:

Volume of surface biomass

(single values and arithmetic mean of 6 test pieces, given in ml / referring to 800 cm²)

Start of test: 18.10.2017		1-month values		2-month values		3-month values
18.10.2017 – 15.11.2017	1a nK pK	(0.01/0.01) 0.01 < 0.01 > 1.5	2a	(< 0.01/ 0.01) -		
15.11.2017 – 12.12.2017	1b nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5	nK pK	< 0.01 > 1.5	3a nK pK	(0.01/0.01) 0.01 < 0.01 > 1.5
12.12.2017 – 09.01.2018	1c nK pK	(< 0.01/ 0.01) - < 0.01 > 1.5				

Limiting values [ml / 800 cm²] pursuant to DVGW Technical Standard W 270 (11/2007)

General application: arithmetic means	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)
Large surface seals (D 1): arithmetic means	≤ (0.12 + 0.03) whereas 1c ≤ 1b	≤ (0.12 + 0.03)	≤ (0.12 + 0.03) whereas 3a ≤ 2a
Small surface seals (D 2): arithmetic means	≤ (0.20 + 0.03) whereas 1c ≤ 1b	≤ (0.20 + 0.03)	≤ (0.20 + 0.03) whereas 3a ≤ 2a
Negative Control:	< 0.01 ml	< 0.01 ml	< 0.01 ml
Positive Control:	≥ 1.5 ml	≥ 1.5 ml	≥ 1.5 ml

Assessment:

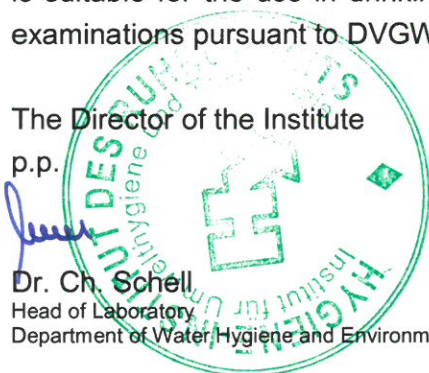
Provided that it is applied correctly, the material

POKETONE M330F

is suitable for the use in drinking water systems according to the results of the microbiological examinations pursuant to DVGW Technical Standard W 270 (11/2007).

The Director of the Institute
p.p.

Dr. Ch. Schell
Head of Laboratory
Department of Water Hygiene and Environmental Microbiology

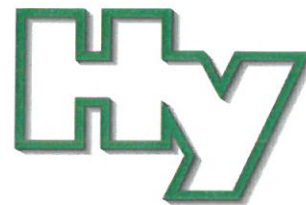


Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Toxikologie

Direktor: Prof. Dr. rer. nat. L. Dunemann

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V.



Hygiene-Institut · Postfach 10 12 55 · 45812 Gelsenkirchen

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Internet www.hyg.de

Reference: W-294068e-18-SI/to
Contact person: Mrs. Dr. Ch. Schell

Gelsenkirchen, 17.01.2018

TEST REPORT

Enhancement of Microbial Growth on Materials to Come into Contact with Drinking water
Test pursuant to DVGW Technical Standard W 270, November 2007

Client: Hyosung Corporation
119, Mapo-daero, Mapo-gu
SEOUL
REPUBLIC OF KOREA

Ordering date: 17.07.2017

Description of the material:

Test material:	POKETONE M930F
Composition:	recipe submitted and checked (7352)
Processing instructions:	for specifications, consult the client
Field of application:	for specifications, consult the client
Quantity of material per area unit:	for specifications, consult the client

Test samples:

Nature and property:	25 plates of hard plastics yellow-beige, 12.5 cm x 12.5 cm x 0.3 cm
Manufacturing:	carried out by the client (description submitted)
Processing conditions:	carried out by the client (description submitted)

Date of receipt of test samples: 27.07.2017

Storing conditions in the testing laboratory until start of test: at room temperature

This test report consists of 3 pages.

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Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V., Vereinsregister: VR 519 Amtsgericht Gelsenkirchen, USt.-ID: DE125018356
Vorstand: Prof. Dr. Werner Schlake (Vors.), Prof. Dr. Jürgen Kretschmann, Dr. Emanuel Grün, Dr. Dirk Waider, Prof. Dr. Lothar Dunemann (geschäftsführ. Vorstand)



Test conditions:

The tests were performed in accordance with the recommendations contained in DVGW Technical Standard W 270 as of November 2007. Details regarding testing procedures, as well as testing conditions will be given in said Technical Standard. The surface of the examined test pieces totals to approx. 930 cm² each. Using six test items per test period the following test scheme was applied:

- monthly sampling of surface biomass (test period 3 months altogether)
- sampling after 2 months (test period 2 months altogether)
- sampling after 3 months (test period 3 months altogether)

Prior to testing, the test specimens were placed in running tap water for 20 hours, followed by a disinfection procedure using 1% chlorine bleach for 30 ± 5 minutes and then rinsed with drinking water.

Time of exposure:

1-month samples	1a:	1 st	test period from 18.10.2017 to 15.11.2017
	1b:	2 nd	test period from 15.11.2017 to 12.12.2017
	1c:	3 rd	test period from 12.12.2017 to 09.01.2018
2-month samples	2a:	1 st	test period from 18.10.2017 to 12.12.2017
3-month samples	3a:	1 st	test period from 10.10.2017 to 09.01.2018

The exposure took place in containers filled with ground water of drinking water quality at a continuous flow rate of approx. 20 l/h over a period of three months. The water temperature ranged from 8.9°C to 9.3°C.

After one, two and three months the surfaces of the test pieces, as well as the corresponding negative reference samples (stainless steel) and positive reference samples (paraffin) were scraped clean in order to examine for biofilm formation. Afterwards, the surface biomass was transferred to suitable centrifuge tubes. The subsequent centrifugation was carried out at 3.000 x g for 10 minutes followed by the determination of the volume of the sediment.

Test results:

The positive reference sample (pK) showed a pronounced formation of biofilm during all test periods. There was no formation of surface biomass on the negative reference sample (nK).

The results of the analyses of the single specimens of approx. 930 cm² surface in total, pursuant to DVGW Technical Standard W 270 were as follows:

Volume of surface biomass

(single values and arithmetic mean of 6 test pieces, given in ml / referring to 800 cm²)

Start of test: 18.10.2017		1-month values		2-month values		3-month values
18.10.2017 – 15.11.2017	1a nK pK	(0.01/< 0.01) - < 0.01 > 1.5	2a	(< 0.01/ <0.01) - < 0.01 > 1.5		
15.11.2017 – 12.12.2017	1b nK pK	(< 0.01/< 0.01) - < 0.01 > 1.5	nK pK		3a nK pK	(0.01/< 0.01) - < 0.01 > 1.5
12.12.2017 – 09.01.2018	1c nK pK	(< 0.01/ 0.01) - < 0.01 > 1.5				

Limiting values [ml / 800 cm²] pursuant to DVGW Technical Standard W 270 (11/2007)

General application: arithmetic means	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)	≤ (0.05 + 0.02)
Large surface seals (D 1): arithmetic means	≤ (0.12 + 0.03) whereas 1c ≤ 1b	≤ (0.12 + 0.03)	≤ (0.12 + 0.03) whereas 3a ≤ 2a
Small surface seals (D 2): arithmetic means	≤ (0.20 + 0.03) whereas 1c ≤ 1b	≤ (0.20 + 0.03)	≤ (0.20 + 0.03) whereas 3a ≤ 2a
Negative Control:	< 0.01 ml	< 0.01 ml	< 0.01 ml
Positive Control:	≥ 1.5 ml	≥ 1.5 ml	≥ 1.5 ml

Assessment:

Provided that it is applied correctly, the material

POKETONE M930F

is suitable for the use in drinking water systems according to the results of the microbiological examinations pursuant to DVGW Technical Standard W 270 (11/2007).

The Director of the Institute
p.p.

Dr. Ch. Schell
Head of Laboratory
Department of Water Hygiene and Environmental Microbiology



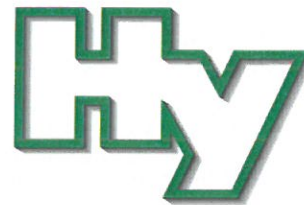
Hygiene-Institut des Ruhrgebiets

Institut für Umwelthygiene und Toxikologie

Direktor: Prof. Dr. rer. nat. L. Dunemann

Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V.

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Fax (0049209) 9242-222
E-Mail c.schell@hyg.de
Internet www.hyg.de

Reference: W-294066e-18-SI/to
Contact person: Mrs. Dr. Ch. Schell

Gelsenkirchen, 17.01.2018

TEST CERTIFICATE

Enhancement of Microbial Growth on Materials to Come into Contact with Drinking water
Test pursuant to DVGW Technical Standard W 270, November 2007

Client: Hyosung Corporation
119, Mapo-daero, Mapo-gu
SEOUL
REPUBLIC OF KOREA

Test material: POKETONE F GRADES

Tested versions: POKETONE M730F / POKETONE M330F / POKETONE M930F

Test method: Material test

The material **POKETONE F Grades**, tested in the version:

- **POKETONE M730F** (test report **W-294066e-18-SI/to** / dated **17.01.2018**)
- **POKETONE M330F** (test report **W-294067e-18-SI/to** / dated **17.01.2018**)
- **POKETONE M930F** (test report **W-294068e-18-SI/to** / dated **17.01.2018**)

is conform to the requirements for the use in the area of drinking water systems pursuant to DVGW Technical Standard W 270. Details regarding testing procedure and test results are itemized in the test reports. This test certificate also covers the materials **POKETONE M130F**, **POKETONE M430F**, **POKETONE M530F** and **POKETONE M630F** (all in material colour).

This test certificate is valid from the date of issue and, given that the conditions and requirements remain unaltered, expires on **17.01.2023**. Upon request of the client, the validity may be extended up to another 5 year term provided that the specifications of Technical Standard W 270 are met.

The Director of the Institute

p.p.

Dr. Ch. Schell

Head of Laboratory

Department of Water Hygiene and Environmental Microbiology

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Träger: Verein zur Bekämpfung der Volkskrankheiten im Ruhrkohlengebiet e.V., Vereinsregister: VR 519 Amtsgericht Gelsenkirchen, USt.-ID: DE125018356
Vorstand: Prof. Dr. Werner Schlake (Vors.), Prof. Dr. Jürgen Kretschmann, Dr. Emanuel Grün, Dr. Dirk Waider, Prof. Dr. Lothar Dunemann (geschäftsführ. Vorstand)