



ОБЩЕСТВО С ОГРАНИЧЕННОЙ ОТВЕТСТВЕННОСТЬЮ
«НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ПО СТРОИТЕЛЬСТВУ
И ЭКСПЛУАТАЦИИ ОБЪЕКТОВ ТЭК»
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APPROVED

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CONCLUSION

№ 4/1 35

on the external three-layered polyethylene pipe coating produced by
JSC "Chelyabinsk tube rolling plant" (process line UAPT-2) made on the basis
of the insulating materials by "KCC Corporation" and "Hyundai Engineering Plastics Co., Ltd"

In accordance with contract № 4/pr-08/75 dated March 19, 2008 (item 4 of the Working program) "Institute VNIIST Ltd" has performed the long-run tests of the external three-layered polyethylene pipe coating produced by JSC "Chelyabinsk tube rolling plant" in order to determine the Specifications for coated pipes TU 14-3R-66-2003 "Steel seamless and welded pipes in diameter 102-1420 mm with the external three-layered anticorrosive coating on the basis extruded polyethylene" and to the requirements by JSC "Transneft" OTT 04.00-27.22.00-KTN-005-1-03.

The three-layered polyethylene coating was applied onto the steel pipes Ø 1220×14 mm on the process line of the external insulation of the pipes at UAPT-2 JSC "Chelyabinsk tube rolling plant". The modes of the coating application were recommended by the companies producing the insulating materials.

- The application of the three-layered coating was carried out with using the insulating materials:
- powder epoxy primer "KARUMEL EX 4413-L300 (II) B/Green" by "KCC Corporation" (lot № JC-70806024)
 - adhesive composition "SUPOL LE 149V" by "Hyundai Engineering Plastics Co. Ltd" (lot № 707010363),
 - polyethylene composition "SUPOL ET 509B" by "Hyundai Engineering Plastics Co. Ltd" (lot № 707070151)

The coating was applied on the pipes after surface clearing and its preliminary treatment by the water chromate solution "Accomet PC" by "Chemetall"

The technological modes of the coating application and the results of its acceptance testing are recorded in the Protocol № 28 of January 21 2008 at JSC "Chelyabinsk tube rolling plant"

The tests of the three-layered polyethylene pipe coating were carried out in accordance with the techniques of Russian standard GOST R 51164-98 "Steel pipe mains. General requirements for corrosion protection" and the Specifications for coated pipes TU 14-3R-66-2003 by JSC "Chelyabinsk tube rolling plant"

To perform the testing the test samples of the coating were cut out from insulated pipes № 104146/104147 and submitted to "Institute VNIIST Ltd". The sizes of the samples: 150×150 mm, 150×100 mm, 100×100 mm 190×36 mm. Besides, were submitted the free film specimens (the external polyethylene coating without the epoxy primer and adhesive interlayer)

The results of testing of the three-layered polyethylene pipe coating produced by JSC "Chelyabinsk tube rolling plant" on the basis insulating materials by "KCC Corporation" and "Hyundai Engineering Plastics Co. Ltd" are shown in table 1

Table 1

RESULTS OF ASSEMBLY TESTING

of the external three-layered polyethylene pipe coating produced by JSC "Chelyabinsk tube rolling plant" (process line UAPT-2) made on the basis of the insulating materials by firms "KCC Corporation" and "Hyundai Engineering Plastics Co., Ltd"

Properties of the coating	Test results	Norm for the coatings according to technical requirements TU 14-3R-66-2003 and OTT 04.00-27.22.00-KTN-005-1-03			
		Normal version N-1, Type 1	Normal heat-resistant N-2, Type 2	Normal frost-resistant N-3, Type 3	Special version S-4, Type 4
1 Appearance	meets the requirements	The coating should have a homogeneous surface of black color without peeling and any visually ascertained flaws (burn-outs, blisters, beads, dents, misses, etc.)			
2. Thickness of the coating mm, for pipes of nominal diameter: smaller or equal to Ø 273 mm greater than Ø 273 mm or equal to Ø 530 mm greater than Ø 530 mm or equal to Ø 820 mm greater than Ø 820 mm	3,0 – 5,2 (avg 4,0)	no less than: 2,0 2,2 2,5 3,0	no less than: 2,0 2,2 2,5 3,0	no less than: 2,0 2,2 2,5 3,0	no less than. 2,2 2,5 3,0 3,5
3. Dielectric continuity kV	over 25	No break-down at electric voltage 5 kV per 1 mm of thickness of the coating + 5 kV in addition			
4. Strength on impact of the coating, J/mm of thickness, at temperature: minus (45±3)°C minus (40±3)°C (20±5)°C (60±3)°C	over 12 over 12 11 / 12 6 / 7	no less than: — 6 (8)* 5 (6)* 3 (4)*	no less than: — 6 (8)* 5 (6)* 4 (5)*	no less than. 7 (8)* — 5 (6)* 3 (4)*	no less than. — 8 (10)* 7 (8)* 5 (6)*
5. Initial adhesion of the coating to steel, N/cm of width, at temperature: (20±5)°C (60±3)°C (80±3)°C	avg 397 avg 132 avg 63	no less than: 100 (150)* 50 (75)* —	no less than. 150 (200)* 75 (100)* 50 (75)*	no less than 100 (150)* 50 (75)* —	no less than. 150 (200)* 50 (75)* —

Continuation table 1

Properties of the coating	Test results	Norm for the coatings according to technical requirements TU 14-3R-66-2003, OTT 04.00-27.22.00-KTN-005-1-03			
		Normal version N-1, Type 1	Normal heat-resistant N-2, Type 2	Normal frost-resistant N-3, Type 3	Special version S, Type 4
6. Adhesion of the coating to steel N/cm of width after immersion in water for 1000 hrs at temperature: (20±5)°C (60±3)°C (80±3)°C	avg. 387 avg. 309 avg. 168	— — —	— — —	— — —	— — —
7 Decrease of adhesion of the coating to steel, % of the initial value, after immersion in water for 1000 hrs at temperature: (20±5)°C (60±3)°C (80±3)°C	2,5 22,2 57,7	no more than: 30 33 —	no more than: 30 33 50	no more than: 30 33 —	no more than: 30 33 —
8. Square of cathodic disbanding of the coating cm ² after immersion for 30 days in 3 % NaCl solution at temperature: (20±5)°C (60±3)°C (80±3)°C	avg. 0,2 avg. 2,2 avg. 11,6	no more than: 4,0 10,0 —	no more than: 4,0 10,0 15,0	no more than 4,0 10,0 —	no more than. 3,0 7,0 —
9. Transient resistance of the coating in 3 % NaCl solution, Ohm m ² . — initial value at temperature (20±5)°C — after immersion for 100 days at temperature (20±5)°C — after immersion for 100 days at temperature (80±3)°C	avg. 2,5 10 ¹² avg. 7,7 10 ¹¹ avg. 3,9 10 ¹²	no less than. 10 ¹⁰ 10 ⁹ —	no less than. 10 ¹⁰ 10 ⁹ 10 ⁸	no less than. 10 ¹⁰ 10 ⁹ —	no less than. 10 ¹⁰ 10 ⁹ —

Continuation table 1

Properties of the coating	Test results	Norm for the coatings according to technical requirements TU 14-3R-66-2003, OTT 04.00-27.22.00-KTN-005-1-03			
		Normal version N-1, Type 1	Normal heat-resistant N-2, Type 2	Normal frost-resistant N-3, Type 3	Special version S, Type 4
10. Resistance to penetration (indentation), mm at temperature. (20±5)°C (60±3)°C (80±3)°C	avg. 0,05 avg. 0,12 avg. 0,18	no more than: 0,2 0,3 —	no more than 0,15 0,2 0,4	no more than 0,2 0,3 —	no more than 0 15 0 2 —
11 Strength of the coating to thermal cycling, thermal-fatigue life without peeling and cracking of the coating at various temperatures. minus (50±3)°C / plus (20±5)°C minus (60±3)°C / plus (20±5)°C	over 10 over 10	no less than: 10 —	no less than. 10 —	no less than. — 10	no less than 10 —
12. Shear of the coating on steel under influence of static loading at temperature (20±5)°C, m/s	less than 10 ⁻¹⁰	—	—	—	no more than 10 ⁻¹⁰
13. Tensile strength of free films, MPa, at temperature: (20±5)°C (60±3)°C	avg 25,1 over 15,0	no less than. 12 10	no less than: 12 10	no less than. 12 10	no less than. 18 15
14. Relative elongation at break of free films, %, at temperature. minus (45±3)°C minus (40±3)°C (20±5)°C	avg. 129 avg. 243 avg. 841	no less than: — 100 350	no less than. — 100 350	no less than. 100 — 350	no less than. — 100 350
15. Cracking resistance of the coating at temperature (50±3)°C, hr	over 1000	no less than 1000	no less than 1000	no less than 1000	no less than 1000

Continuation table 1

Properties of the coating	Test results	Norm for the coatings according to technical requirements TU 14-3R-66-2003, OTT 04.00-27.22.00-KTN-005-1-03			
		Normal version N-1, Type 1	Normal heat-resistant N-2, Type 2	Normal frost-resistant N-3, Type 3	Special version S, Type 4
16. Mould resistance, grade	2	no more than 2	no more than 2	no more than 2	no more than 2
17 Resistance of the coating to UV radiation flux of 600 kW·hr/m at temperature (50±3)°C, hr	over 500	no less than 500	no less than 500	no less than 500	no less than 500
17.1 Relative elongation at break of free films, %, after ageing test in UV irradiation chamber for 500 hrs at temperature (50±3)°C	avg. 658	—	—	—	—
17.2. Decrease of relative elongation at break, % of the initial value, after ageing test in UV irradiation chamber for 500 hrs at temperature (50±3)°C	21.8	no more than 25	no more than 25	no more than 25	no more than 25
17.3. Melt flow rate of polyethylene, g/10 min (190°C / 2.16 kg)	avg. 0,35	—	—	—	—
17.4. Melt flow rate of polyethylene, g/10 min, after ageing test in UV irradiation chamber for 500 hrs at temperature (50±3)°C	avg. 0,32	—	—	—	—
17.5. Change of melt flow rate of polyethylene, % of the initial value, after ageing test in UV irradiation chamber for 500 hrs at temperature (50±3)°C	8,7	no more than 35	no more than 35	no more than 35	no more than 35

Continuation table 1

Properties of the coating	Test results	Norm for the coatings according to technical requirements TU 14-3R-66-2003, OTT 04.00-27.22.00-KTN-005-1-03			
		Normal version N-1, Type 1	Normal heat-resistant N-2, Type 2	Normal frost-resistant N-3, Type 3	Special version S, Type 4
18. Thermostability					
18.1 Relative elongation at break of free films, %, after air-exposure at temperature (110±3)°C for					
– 1000 hrs	avg 674	–	–	–	–
– 100 days	avg 534	–	–	–	–
18.2. Decrease of relative elongation at break, % of the initial value, after air-exposure at temperature (110±3)°C for					
– 1000 hrs	19,9	no more than 25	–	no more than 25	no more than 25
– 100 days	36,5	–	no more than 25	–	–
18.3. Melt flow rate of polyethylene, g/10 min after air-exposure for 100 days at temperature (110±3)°C	0 323	–	–	–	–
18.4. Change of melt flow rate of polyethylene, % of the initial value, after air-exposure for 100 days at temperature (110±3)°C	8,8	no more than 35	no more than 25	no more than 35	no more than 35
Notes					
1 As far as items 4, 5 of the technical requirements TU 14-3R-66-2003 and OTT 04.00-27.22.00-KTN-005-1-03 – in brackets – for pipes of diameter greater than Ø 820 mm without brackets – for pipes of diameter smaller or equal to Ø 820 mm					
2 As far as item 9 test data after immersion for 72 days in 3 % NaCl solution at the temperature (20±5)°C, (80±3)°C.					

SUMMARY

By the results of the preproduction testing of pipes $\varnothing 1220 \times 14$ mm the external three-layered polyethylene coating applied at the product line of the external insulation of the pipes at UAPT-2 JSC "Chelyabinsk tube rolling plant" with using of the system of the insulating materials: water chromate solution "Accomet PC" by "Chemetall" powder epoxy primer "KARUMEL EX 4413-L300 (II) B/Green" by "KCC Corporation", adhesive composition "SUPOL LE 149V" and polyethylene composition "SUPOL ET 509B" by "Hyundai Engineering Plastics Co. Ltd" be able to doing the following conclusions:

1 The three-layered coating meets the requirements of the Specifications TU 14-3R-66-2003 "Steel seamless and welded pipes in diameter 102–1420 mm with the external three-layered anti-corrosive coating on the basis extruded polyethylene" and to the General technical requirements OTT 04.00-27.22.00-KTN-005-1-03 by JSC "Transneft" imposed to the plant polyethylene pipe coatings of:

- normal version – for construction of pipelines with the temperature of transporting products up to plus 60°C (type N-1 by TU 14-3R-66-2003, type 1 by OTT 04.00-27.22.00-KTN-005-1-03)
- normal version with the increased frost-resistance – for construction of pipelines in conditions of Eastern Siberia and Far North (type N-3 by TU 14-3R-66-2003, type 3 by OTT 04.00-27.22.00-KTN-005-1-03)
- special version – for construction of underwater transitions and pipelines sites by methods of the "closed" lining (type S by TU 14-3R-66-2003, type 4 by OTT 04.00-27.22.00-KTN-005-1-03)

2. The three-layered coating does not meet the requirements of the Specifications TU 14-3R-66-2003 and OTT 04.00-27.22.00-KTN-005-1-03, imposed to the plant polyethylene pipe coatings of normal version with the increased (up to plus 80°C) heat-resistance (type N-2 by TU 14-3R-66-2003, type 2 by OTT 04.00-27.22.00-KTN-005-1-03) on the properties: "adhesion of the coating to steel at temperature 80°C " (item 5 of table 1) for pipes of diameter greater than $\varnothing 820$ mm and "decrease of adhesion of the coating to steel after immersion in water for 1000 hrs at temperature 80°C " (item 7 of table 1), "decrease of relative elongation at break after air-exposure for 100 days at temperature $(110 \pm 3)^{\circ}\text{C}$ " (item 18.2 of table 1)

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