

Study on Release Performance of Concrete Release Agent

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Abstract. *In this paper, the effects of types of concrete release agent, the amount of brushing per unit area and the 1d's strength of concrete on the release performance were studied. The adhesion and film forming ability of O/W emulsion release agent was improved by adding high polymer. The results show that the 1d's strength of concrete has no effect on the release performance of the release agent. The most important factors affecting the release performance are brushing amount per unit area and the type of release agent. O/W emulsion release agent with polyacrylamide and polyethylene glycol all stick mold. The more they are added, the heavier the stickiness is. While, the release performance with polyethylene glycol is very close to blank sample.*

Key words: *Concrete release agent, Release performance, Strength of 1d's.*

1 Introduction

Concrete is one of the most used building materials in the world today. At first, people only cared about its strength. With the progress of society, concrete has been endowed with more and more functions and requirements, such as high strength, high corrosion resistance, crack and permeability resistance, and art-flow equality. The appearance of fair-faced concrete marks that concrete has a new higher requirement -- decorative. Fair-faced concrete not only has strict requirements on raw materials, mix ratio and construction technology, but also puts forward high requirements on concrete release agent. As an essential concrete admixture, release agent can reduce or even eliminate the adhesion between concrete and mould, so that the two are stripped smoothly, and the edges and corners of concrete components are neat and undamaged, and the surface color is uniform and smooth. Many domestic and foreign fair-faced concrete components have used special concrete release agent. According to the industry standard JCT 949-2005 Release Agent for Concrete Products, the most important indicator to evaluate the performance of release agent is the adhesive amount per unit area on the mould after the release of concrete components. The lower the adhesive amount, the better the performance of release agent. However, there are few researches on the factors affecting the surface adhesion of mould.

2 Materials and Methods

(1) Experimental raw materials: P.O 42.5 cement, Shandong Shanshui Cement Factory; Medium river sand with fineness modulus of 2.6~2.9 and sand rate of 36%~40%. The stone particle size

is 5mm~20mm, two stages. Polyacrylamide, formula weight 8 million, Gongyi Novel Polymer Co., LTD.; Polyvinyl Alcohol, Jinan Jinniu Chemical Co.,LTD.; Polyethylene glycol, Hai'an Petrochemical. Admixture using Polycarboxylate superplasticizer produced by our company, solid content is 41%, water reduction rate is 35%; Release agent with our company's TM-1(O/W emulsion) and TM-2(W/O emulsion) concrete release agent, waste oil.

(2)Experimental equipment: 60 L concrete mixer; 100 mm × 100 mm × 100 mm plastic mold; Electronic scale.

(3)Experimental steps: Put all the concrete materials into the mixer at one time, stir for 3min, and then manually stir for 2 to 3 times after discharging, and then load them into the mold that has been coated with release agent in advance. The proportions of concrete mix is shown in Table 1.

Table 1. Proportions of concrete mix.

Concrete mix no.	42.5cement	Fly ash	Sand	Stone	W	AD
A	320	80	846	994	142	6
B	320	80	846	994	160	3.5
C	320	80	846	994	170	0

After the concrete test blocks is demoulded, the surface adhesion of the mold is counted as the sum of the bottom and elevation. The specific methods are as follows: 1. The mold without demoulding agent is first weight, and recorded the weight as “a”, which is the initial weight of the mold. 2. Brush release agent, record the weight as “b” when the release agent completely dry; 3.Preparation the concrete blocks, with the brushed release agent mold , and immediately clean the mold surface after forming , wipe clean with wet cloth, so as to avoid difficult to clean when the concrete hardening , causing data interference; 4. Demoulding the concrete test block after curing at room temperature for 24 hours, and record the weight of the mold after demoulding as weight “c”; 5. Observe the test block after demoulding, observe whether the surface and edges are intact, and test the strength of one day. (b-a) /0.15 refers to the effective brushing amount per unit area, (c-b) /0.15 refers to the adhesion amount per unit area on the mold, and the unit is g/m².

Added different mass fractions of polyacrylamide, polyvinyl alcohol and polyethylene glycol into TM-1 at 0.5‰, 1‰ and 1.5‰. The above experimental steps were repeated with ratio A to observe the influence of thickening components on the performance of release agent.

3 Results

3.1 The Influence of the Type and Amount of Release Agent on the Release Effect

The concrete mix ratio A was used to carry out the demoulding experiment on three kinds of demoulding agents, and the results were shown in Table 2, Table 3 and Figure 1 and Figure 2.

Table 2. Demoulding experiment of TM-2 and waste oil.

No.	Type	First weight "a" (g)	Dry weight "b"(g)	Effective amount (g)	Effective amount per unit area(g/m^2)	demoulded as weight "c"(g)	Adhesion weight (g)	Adhesion per unit area (g/m^2)	1d's Strength (MPa)
1	TM-2	1029	1029.5	0.5	3.33	1029.8	0.3	2.00	15.89
2		1029	1029.5	0.5	3.33	1029.9	0.4	2.67	16.71
3		1030.7	1031.4	0.7	4.67	1032	0.6	4.00	17.02
4		1028.9	1029.7	0.8	5.33	1030	0.3	2.00	16.69
5		1028.5	1029.6	1.1	7.33	1030.3	0.7	4.67	16.83
6		1027.1	1028.4	1.3	8.67	1029	0.6	4.00	16.70
7		1039.1	1040.5	1.4	9.33	1041.2	0.7	4.67	16.22
8	Waste oil	1028.8	1030.5	1.7	11.33	1030.1	-0.4	-2.67	16.45
9		1028.1	1031.7	3.6	24.00	1029.8	-1.9	-12.67	16.38

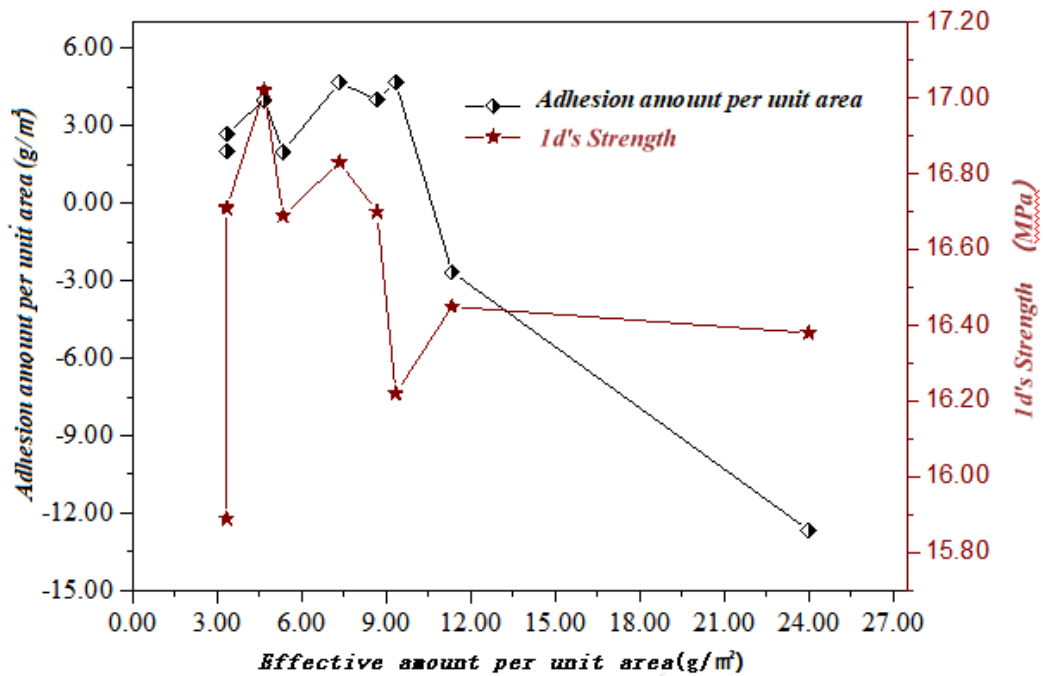


Figure 1. Adhesion amount of TM-2 and waste oil and 1 day strength

In Figure 1, the first seven horizontal points are the corresponding data of release agent TM-2, and the last two are the corresponding data of waste oil. It can be seen from the results that the adhesion of the two groups of waste oil brushing molds after release is negative, and the higher the amount of brushing, the greater the absolute value of the negative. This shows that in the process of concrete demoulding, the cohesion of the demoulding agent layer is damaged, waste oil on both the surface of the concrete and mold, and the concrete surface is polluted. The more the waste oil brushed, the more move to the concrete surface. TM-2 in low brushing amount, unit surface adhesion is small; With the increase of effective amount of brushing, the adhesive amount tends to increase. When TM-2 effective brushing amount is lower than 9.33 g/m^2 , after demoulding unit area adhesion can meet the industry standard (less than 5 g/m^2).

Table 3. Demoulding experiment of TM-1

No.	First weight "a" (g)	Dry weight "b"(g)	Effective amount(g)	Effective amount per unit area(g/m^2)	demoulded as weight "c"(g)	Adhesion weight(g)	Adhesion per unit area (g/m^2)	1d's Strength (MPa)
1	1027.8	1028	0.2	1.33	1028.2	0.20	1.33	16.10
2	1027.8	1028.1	0.3	2.00	1028.3	0.20	1.33	16.23
3	1027.4	1028	0.6	4.00	1028	0.00	0.00	15.87
4	1027.9	1029	1.1	7.33	1028.7	-0.30	-2.00	15.97
5	1027.8	1028.9	1.1	7.33	1028.3	-0.60	-4.00	16.26
6	1027.7	1028.9	1.2	8.00	1027.8	-1.10	-7.33	15.99
7	1028.8	1030.1	1.3	8.67	1029.3	-0.80	-5.33	15.36
8	1027.4	1028.7	1.3	8.67	1027.8	-0.90	-6.00	16.01

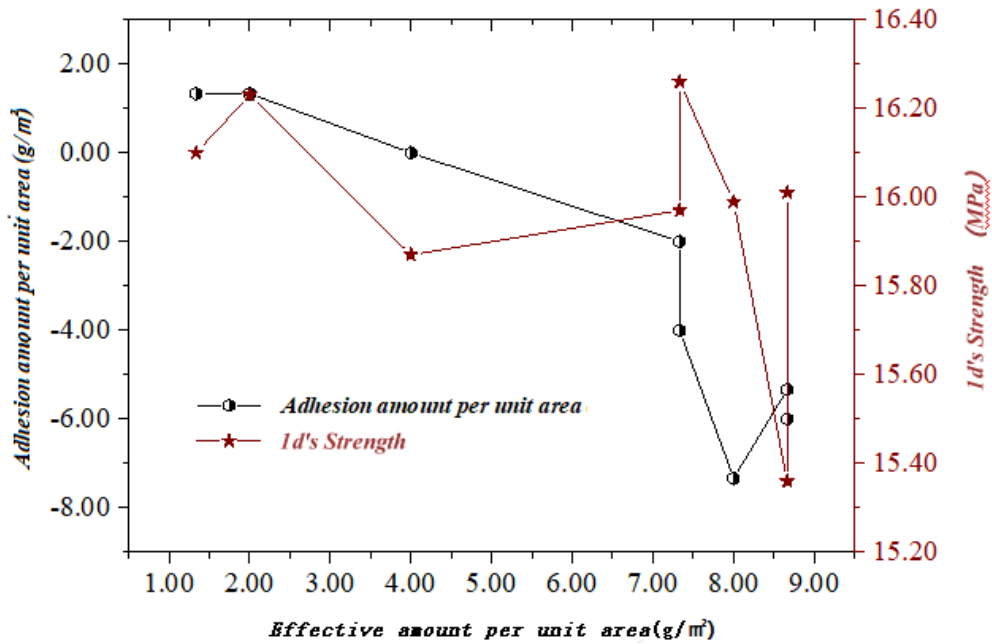


Figure 2. Adhesion amount of TM-1 and 1 day strength

It can be seen from the results in Table 3 and Figure 2 that with the increase of effective brushing amount, the adhesive amount on the mold surface gradually decreases. When the effective brushing amount per unit area is 4g/m², adhesion is less than 0.01g, less than the lowest grading value of the electronic scale we used. When the effective brushing amount per unit area is 7.33g/m², the surface adhesion of the mold is negative, indicating that there is a situation similar to the waste oil release agent, the concrete test block surface has adhesion of a small amount of TM-1.

Above experimental results show that the type of release agent and its brushing amount per unit area have no effect on the 1d's strength of concrete. Similarly, the 1d's strength of concrete has no obvious effect on the adhesion amount per unit area of the mold surface after demoulding. The most important factors affecting the adhesion are the brushing amount per unit area of release agent and the type of release agent. Efficient release agent can achieve good release performance in the case of low unit area brushing amount. When the brushing amount per unit area exceeds a certain value, the cohesion of the release agent layer will be destroyed, resulting in the release agent on the surface of the concrete and the surface of the mold, polluting the surface of the concrete, so the brushing thickness should be strictly controlled. Due to the viscosity of waste oil, it is difficult to control the thickness of brushing. Although it can meet the demoulding requirements, it is too polluted to the surface of concrete.

3.2 The Influence of Thickening Components on the Demoulding Effect

The demoulding results of TM-1 with thickening components are shown in Table 5. The results show that the demoulding adhesion of TM-1 increased by polyacrylamide and polyvinyl

alcohol is too large, and demoulding is difficult, indicating that these two thickening components play a bonding effect, resulting in the adhesion between the concrete surface and the mold. The release adhesion amount of TM-1 with polyethylene glycol was close to that of the blank group without thickening component, and the release was successful, indicating that polyethylene glycol as thickening component had little effect on the release performance.

Table 5. Release performance of TM-1 with thickening components

thickening components' type	mass fractions	Effective amount per unit area(g/m ²)	Adhesion per unit area (g/m ²)	release performance
Blank	0‰	2.00	1.33	Easy
	0.5‰	2.03	9.65	Vary hard
polyacrylamide	1‰	2.01	14.11	Vary hard
	1.5‰	2.03	16.57	Vary hard
	0.5‰	2.00	4.67	Hard
Polyvinyl alcohol	1‰	2.03	8.87	Vary hard
	1.5‰	2.06	13.30	Vary hard
	0.5‰	2.11	1.36	Easy
Polyethylene glycol	1‰	2.04	1.46	Easy
	1.5‰	1.98	1.88	Easy

4 Conclusions

- The type of release agent and its brushing amount per unit area have no effect on the 1d's strength of concrete, and the 1d's strength of concrete has no obvious effect on the adhesion amount per unit area of the mold surface after release. The most important factors affecting the adhesion are the type of release agent and the brushing amount.
- due to the viscosity, the waste oil as release agent will be brushed very thick, and the cohesion of the release agent layer will be destroyed when the test block is released, resulting in the release agent on the surface of the concrete and the surface of the mold, and the concrete surface is polluted.
- TM-2(W/O emulsion) concrete release agent produced by our company, the adhesion amount of mold is small when brushing amount is small, with the increase of brushing amount, the adhesion amount has an increasing trend. The W/O emulsion has the property of bonding, brushing thick resulting in the concrete surface and mold bonding, the effective brushing amount should be controlled in 9.33 g/m² below.
- TM-1(O/W emulsion) concrete release agent produced by our company, in the unit area effective brushing amount of 4 g/m², adhesion amount less than 0.01 g/m². When the effective brushing amount per unit area reached 7.33 g/m², the adhesion amount of the mold was negative, the cohesion of the release agent layer was destroyed, and the surface of the concrete test block adhered few release agent.
- When TM-1 was added with polyacrylamide and polyvinyl alcohol, the sticky mold phenomenon appeared, and the more the amount added, the heavier the sticky mold

phenomenon. The release performance of polyethylene glycol is very close to blank sample, indicating that polyethylene glycol is an excellent thickening component in emulsion release agent.

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