RESEARCH ON MANUFACTURING DRY MIXED CEMENT MORTAR WITH HIGH COMPRESSIVE STRENGTH, HIGH FLEXURAL STRENGTH, LOW SHRINKAGE AND HIGH WATERTIGHTNESS FOR RESTORATION OF DAMAGED HYDRAULIC STRUCTURES IN VIETNAM

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Abstract. Using normal materials to manufacture the mixed mortar is necessary for restoration of hydraulic structures in Vietnam. It will salvage the materials and decreases the cost price of the mortar. In this research, we used cement made in Vietnam (Chinfon - Haiphong cement), natural sand (Lo River sand), polymer acrylic and high range water reducing (of SIKA company) with proportion 1 : 3 : 0.03 : 0.003 by weight. The water to cement ratio is 0.5, which always ensure the compressive strength of mortar more than 40 MPa and small shrinkage, good watertightness, and high adhesion. That is suitable for the restoration of concrete structures in general and hydraulic structures in particular of Vietnam. The dry mixed mortar is manufactured and in bag of 15±0.5 kg weight.
Keywords: dry mixed cement mortar, compressive strength, shrinkage, flexural strength, adhesion, watertightness, high range water reducing admixture (HRWR), polymer acrylic.

1. INTRODUCTION

After fifty years, many hydraulic structures in Vietnam were damaged and downgraded that why it is necessary to repair them for continuing operated. Here the most important hydraulic structures are made of concrete and reinforced concrete, that when repairing has required the same materials having the same fundamental properties. In order to repair those structures, the mortar from cement with high compressive strength, no shrinkage, and high watertightness is used [1].

The mixed mortars have good properties of some overseas companies are available in Vietnam, but they are very expensive, so they are not suitable for Vietnam situation. Actually, the materials needed to manufacture these mortars are available in Vietnam and we can use them to make a kind of mixed mortar using to repair the damage of structures in general, hydraulic structures in particular. To produce this mixed mortar we can use usual materials Vietnam's.

2. RESEARCH OBJECTIVES

The objective is to manufacture the mixed cement mortar which has high compressive strength, high flexural strength, low shrinkage and high watertightness in order to repair hydraulic concrete structures and reinforced concrete structures. The mortar should have following properties:

+ High watertightness
+ Good slump for application
+ The good adhesion with the parent concrete and mortar
+ High compressive strength ($f'_c \geq 40$ MPa).

3. MATERIALS

3.1. Cement

Chinfon Portland cement PC 40 made in Hai Phong, Vietnam. Its physical properties are shown in Table 1

Table 1. Physical properties of Portland cement PC40 Chinfon - Haiphong

N^o	Item	Unit	Result
1	Compressive strength, 28 days	MPa	42
2	Flexural strength, 28 days	MPa	6.0
3	Setting time: Initial;Final	minute	113; 190
4	Specific gravity	(g/cm^3)	3.10

3.2. Fine aggregate (sand)

In this research, we used the standard sand and the crush silicon sand. The results were very good, but the cost price was very high, therefore we have taken the river sand for experiments [2]. Namely, we used Lo River sand which has some properties as shown in Table 2.

Table 2. Properties of fine aggregate (sand)

N^o	Item	Unit	Result
1	Bulk specific gravity on oven-dry basis	(g/cm^3)	2.65
2	Apparent specific gravity	(g/cm^3)	1.45
3	SSD* Absorption	%	0.4
4	Fineness modulus		2.54

SSD*: Saturated surface-dry

The sand is sieved to reject the grains size > 5 mm. Then it was dried by the oven in temperature of 100-150°C for five hours until the humidity of sand equal zero percent. The sand was packed and kept in the dry condition.

3.3. Polymer

Polymer acrylic is admixture in form of powder, dry, white color, odorless. It is easy to dissolve in the water. The chemical function of Polymer acrylic as shown following [3]:

$$(-CH_2 - CH -)_n$$
$$|$$
$$COOH$$
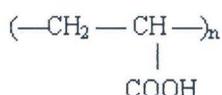
3.4. High range water reducing admixture (HRWR)

High range water reducing admixture has the brand name of Mighty [3]. The main component of Mighty is naphthalene formaldehyde sulphonated. This admixture is being sold in Vietnam.

4. MIXTURE PROPORTION

4.1. Design preliminary proportion mortar

The mortar using in concrete structures and reinforced structures must have high compressive strength (the compressive strength of mortar and the compressive strength of mortar matrix in old concrete is equivalent). However, the polymer mortar has not strength function; in research we designed the proportion mortar was used in compliance with 14 TCN 80-2001 and TCXD 2000 - Building standard [4, 5].

The compressive strength of mortar is calculated by following Eq. (1)

$$f'_v = A.f'_c \left(\frac{C}{W} - 0.8 \right), \tag{1}$$

where: A expresses materials quality, $A=1.05$ for materials of good quality, $A=0.90$ for materials of normal quality, and $A=0.75$ for materials of low quality. f'_v is the required compressive strength of mortar, f'_c is the compressive strength of cement, C and W are respectively the amount of cement and water in 1 m^3 of the mortar.

The cement content is calculated by Eq. (2)

$$C = \frac{1000}{\dfrac{1}{\rho_c} + \dfrac{W}{C} + \dfrac{n}{\rho_s}} \tag{2}$$

where: ρ_c, ρ_s are respectively the bulk specific gravity on oven-dry basis of cement and sand, n is the sand to cement ratio by weight, $n = \frac{1}{(C/S)}$; S is the sand content in 1 m^3 mortar, (C/S) can be chosen in graph of appendix A.2 of the standard branch 14TCN 80-2001.

Then we can calculate the proportion of mortar as follows:

$$1 : S/C : W/C = 1 : 3.0 : 0.50$$

In other hand, the high range water reducing admixture and polymer acrylic are used with the amount of 0.2-0.3% and 2-3%, respectively.

4.2. The experimental scheme method

In this project, we used the experimental scheme method with the orthogonal central turn of two levels and two factors to aim building the statistical mathematics model, based on that to access the effects of factors on the properties of mortar; such as the plasticity, compressive strength, flexural strength, adhesion between the old concrete and new mortar, saturated absorption; thence finding the optimal percent of polymer and HRWR. of real variables and coded variables are presented in Table 3.

Table 3. The experimental scheme

N^o	Coded variables		Real variables	
	X_1	X_2	ξ_1 (%)	ξ_2(%)
1	1	-1	0.30	1
2	-1	-1	0.20	1
3	-1	1	0.20	3
4	1	1	0.30	3
5	0	0	0.25	2
6	1.414	0	0.37	2
7	0	-1.414	0.25	0.6
8	-1.414	0	0.18	2
9	0	1.414	0.25	3.6
10	0	0	0.25	2
11	0	0	0.25	2
12	0	0	0.25	2
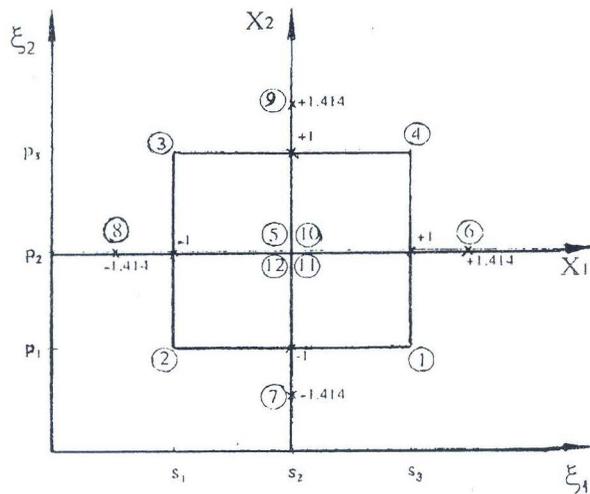
Fig. 1. Sketch of the experimental scheme method with the orthogonal central turn of two levels and two factors

In the experimental scheme method with two levels and two factors, as signed the percent of HRWR (% of cement content) is ξ_1 and the percent of polymer (% of cement content) is ξ_2. For establishing the experimental scheme the real variables ξ_1 and ξ_2 are encoded to become the coded variables X_1 and X_2 (see [6]). The value of the coded variables are chosen in the range of (-1) and (+1), at the centre point of experimental scheme (0), and the values on the axis X_1 and $X_2(+\infty, -\infty)$ to make the rotation of the orthogonal scheme central turn. The sketch of the experimental scheme method with two levels and two factors as shown in Fig. 1 and the scheme

4.3. Research diagram

To research the effects of the admixture on some properties of mortar, we issue the diagram for experiments. The diagram is shown below.

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┌─────────────────────┐   ┌─────────────────────┐   ┌─────────────────────┐
│ Choose proportion of │   │ Design preliminary   │   │ Research properties │
│ HRWR and polymer     │   │ proportion high      │◄──│ of materials        │
│                      │   │ performance mortar   │   │                     │
└──────────┬──────────┘   └──────────┬──────────┘   └─────────────────────┘
           │                         │
           ▼                         ▼
┌─────────────────────┐   ┌─────────────────────┐
│ Research effects of  │   │ Research effects of  │
│ the admixtures on    │──►│ the admixtures on    │
│ setting time of      │   │ slump of mortar      │
│ mortar               │   │                      │
└─────────────────────┘   └──────────┬──────────┘
                                      │
                                      ▼
                          ┌─────────────────────┐
                          │ Research effects of  │
                          │ the admixtures on    │
                          │ compressive and      │
                          │ bending strength of  │
                          │ mortar               │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Research effects of  │
                          │ the admixtures on    │
                          │ capillary pore of    │
                          │ mortar               │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Research effects of  │
                          │ the admixtures on    │
                          │ adhesion of mortar   │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Research effects of  │
                          │ the admixtures on    │
                          │ the length of mortar │
                          │ bar                  │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Research effects of  │
                          │ the admixtures on    │
                          │ watertightness of    │
                          │ mortar               │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Propose manufacturing│
                          │ technology of dry    │
                          │ mortar               │
                          └──────────┬──────────┘
                                      ▼
                          ┌─────────────────────┐
                          │ Stop                 │
                          └─────────────────────┘
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5. RESULTS AND DISCUSSIONS

5.1. The effects of Polymer Acrylic on setting time of mortar

The setting time of mortar with 0%, 1%, 2%, and 3% percentage of Polymer Acrylic are shown in Table 4, respectively.

Table 4. The results of setting time of mortar

% Acrylic	0	1	2	3
Setting time (minutes)				
Initial	113	118	125	115
Final	190	198	195	196

From the results in Table 4 we can see that using Polymer Acrylic of percentage (1-3 %) didn't affect the setting time of mortar.

5.2. The effects of Polymer Acrylic and HRWR on slump of mortar

The slump of the mortar (D_2) is measured by the flow of mortar on shaking table according to 14TCN 80-2001. The function of regression represents the effects of polymer Acrylic and HRWR on slump of mortar is shown in Eq. (3). The results of flat diameter of mortar are shown in Table 5.

$$D_2 = 158.75 + 2.32X_1 - 2.97X_2 - 4.31X_1^2 + 0.69X_2^2 - 4.75X_1X_2, \qquad (3)$$

where: D_2 is the flat diameter of mortar; X_1 and X_2 are the coded variables.

Table 5. The flat diameter of mortar specimens

N^o	D$_2$ (mm)	%
Control	190	100
1	163	86
2	152	80
3	156	82
4	148	78
5	161	85
6	156	82
7	165	87
8	145	76
9	156	82
10	164	86
11	158	83
12	152	80

Note: The flat diameter of mortar with the presence of polymer and HRWR is less than the control specimen (about 13% to 24%) but they ensure good slump for application in Vietnamese climate condition and the accordance in 14TCN 80-2001.

5.3. The effects of the admixtures on compressive strength of mortar

The mortar specimens are moulded in prismatic mould with 160 mm length and 40×40 mm cross section. After 24 hours, they are demoulded and cured in the curing room at humidity 80% and temperature 25±2°C. The specimens are tested to determine compressive strength and flexural strength at ages of 3, 7, and 28 days.

The compressive strength of mortar of 3, 7 and 28 day-ages are shown in Table 6. The compressive strength of mortar are represented by Eq. (4), (5) and (6)

$$f'_{c,3} = 32.535 - 0.575X_1 + 0.707X_2 + 0.297X_1^2 - 0.803X_2^2 + 0.277X_1X_2, \qquad (4)$$

$$f'_{c,7} = 35.534 + 0.417X_1 + 0.119X_2 + 1.166X_1^2 + 1.982X_2^2 + 0.893X_1X_2, \qquad (5)$$

$$f'_{c,28} = 43.937 - 0.436X_1 + 0.997X_2 + 1.044X_1^2 - 0.329X_2^2 + 1.723X_1X_2, \qquad (6)$$

where: $f'_{c,3}$, $f'_{c,7}$, $f'_{c,28}$ is the compressive strength of mortar at 3, 7 and 28 days; X_1 and X_2 are the coded variables

Table 6. The compressive strength of mortar at given ages

N°	3 days		7 days		28 days	
	$f'_{c,3}$ (MPa)	%	$f'_{c,7}$ (MPa)	%	$f'_{c,28}$ (MPa)	%
Control	30.1	100	35.1	100	43.7	100
1	29.3	97	35.3	101	40.3	92
2	32.0	106	37.3	106	43.8	100
3	33.4	111	36.8	105	44.3	101
4	31.9	106	38.4	110	47.7	109
5	32.8	109	36.4	104	47.9	110
6	33.5	111	40.9	117	45.5	104
7	30.8	102	41.8	119	43.9	100
8	33.7	112	38.2	109	47.9	110
9	32.0	106	40.6	116	44.0	101
10	31.6	105	35.7	102	42.8	98
	33.1	110	38.2	109	45.4	104
12	32.9	109	31.9	91	39.7	91

Note: From the results of compressive strength (see Table 6) we can see that the presence of polymer and HRWR doesn't affect on the compressive strength, and after 28 days the difference of compressive strengths of these mortars is negligible. With $W/C = 0.5$, the compressive strength of mortar is usually more than 40 MPa. However, when the admixtures content is high, the compressive strength of mortar attains 47.7 MPa, higher than control mix about 9%.

5.4. The effects of the admixtures on flexural strength of mortar

The flexural strength of mortar at the given ages is shown in Table 7.

The effects of the admixtures on the flexural strength of mortar are represented by Eq. (7), (8) and (9):

$$f'_{b,3} = 7.772 - 0.195X_1 - 0.261X_2 + 0.146X_1^2 - 0.389X_2^2 - 0.267X_1X_2 \qquad (7)$$

$$f'_{b,7} = 8.361 - 0.016X_1 + 0.222X_2 + 0.547X_1^2 + 0.067X_2^2 + 0.117X_1X_2 \qquad (8)$$

$$f'_{b,28} = 8.788 - 0.071X_1 + 0.333X_2 + 0.416X_1^2 + 0.023X_2^2 - X_1X_2 \qquad (9)$$

where: $f'_{b,3}$, $f'_{b,7}$, $f'_{b,28}$ is the flexural strength of mortar at 3, 7 and 28 days; X_1 and X_2 are the coded variables.

Table 7. The flexural strength of mortar at given ages

N^o	3 days		7 days		28 days	
	$f'_{b,3}$ (MPa)	%	$f'_{b,7}$ (MPa)	%	$f'_{b,28}$ (MPa)	%
Control	6.7	100	8.0	100	10.12	100
1	7.5	112	8.8	111	8.14	80
2	8.5	127	8.7	109	9.14	90
3	8.6	128	8.2	103	9.77	97
4	6.5	97	8.9	111	9.27	92
5	6.9	103	8.2	102	8.75	87
6	8.4	125	9.4	118	9.56	94
7	7.3	109	8.1	101	8.12	80
8	7.3	109	10.1	127	9.53	94
9	6.5	96	9.6	120	9.40	93
10	7.8	116	8.8	110	8.91	88
11	8.7	130	8.4	105	9.06	90
12	7.9	114	8.1	102	8.42	83

Note: Compared with control specimen, the flexural strength at 28 days of specimen containing polymer and HRWR are little lower, (about 90% of flexural strength of the control specimen). This reason is the effects of polymer on the structure of cement matrix. However, increasing the density and decreasing the capillary pore of mortar to increase watertightness is aimed, so that the suitable percent of admixtures is necessary to use.

5.5. The effects of the admixtures on the adhered strength to parent mortar of mortar

The adhesion of mortar to parent mortar at 28 days as shown in Table 8.

Table 8. The adhered strength of mortar at 28 days

N^o	28 days	
	$f'_{a,28}$ (MPa)	%
Control	4.3	100
1	4.8	109
2	5.2	120
3	5.7	132
4	6.6	152
5	6.4	147
6	4.3	99
7	5.1	118
8	6.2	142
9	4.9	112
10	6.8	157
11	4.8	111
12	5.7	132

The effects of the admixtures on the adhesion of mortar is shown by Eq.(10):

$$f'_{a,28} = 5.933 - 0.279X_1 + 0.274X_2 - 0.229X_1^2 - 0.037X_2^2 - 0.332X_1X_2 \qquad (10)$$

where: $f'_{a,28}$ is the adhesion strength of mortar at 28 days; X_1 and X_2 are the coded variables

Note: Using polymer and HRWR in mixed mortar increases the adhesion strength of mortar (about 10% to 57%) (see Table 8). We can see that, with the proportion of high range water reducing is 0.225% and polymer is 2.5%, the adhesion strength is 6.6 MPa, that is higher than 52% comparing with control specimen.

5.6. The compressive strength of mortar on compacted sub-grade

The compressive strength of mortar on compacted sub-grade at the given ages (3, 7 and 28 days) is shown in Table 9.

Table 9. The compressive strength of mortar at given ages

N^o	3 days		7 days		28 days	
	$f'_{c,3}$ (MPa)	%	$f'_{c,7}$ (MPa)	%	$f'_{c,28}$ (MPa)	%
Control	18.0	100	34.5	100	41.0	100
1	18.2	101	29.5	86	38.9	95
2	23.4	130	32.2	93	36.3	89
3	24.4	135	34.8	101	39.2	96
4	21.2	118	30.7	89	40.1	98
5	26.6	148	30.0	87	37.7	92
6	21.7	121	29.8	86	36.0	88
7	26.9	149	30.1	87	37.0	90
8	22.3	124	34.1	99	41.0	100
9	26.0	145	36.6	106	46.2	113
10	27.3	152	31.5	91	38.5	94
11	19.9	111	32.1	93	40.2	98
12	23.0	128	27.8	81	37.6	92

The effects of the admixtures on the compressive strength of mortar on compacted sub-grade are represented by Eq. (11), (12) and (13):

$$f'_{c,3} = 24.217 - 1.142X_1 + 0.353X_2 - 1.721X_1^2 + 0.513X_2^2 + 0.517X_1X_2 \qquad (11)$$

$$f'_{c,7} = 30.11 - 1.624X_1 + 1.622X_2 + 0.721X_1^2 + 1.404X_2^2 - 0.367X_1X_2 \qquad (12)$$

$$f'_{c,28} = 37.834 - 0.356X_1 + 0.143X_2 + 0.104X_1^2 + 1.487X_2^2 - 0.4X_1X_2 \qquad (13)$$

where: $f'_{c,3}$, $f'_{c,7}$, $f'_{c,28}$ are the compressive strength of mortar on compacted sub-grade at 3, 7 and 28 days; X_1 and X_2 are the coded variables

Note: Polymer and HRWR affect little on the compressive strength of mortar on compacted sub-grade as prescribed in TCVN (Vietnamese standard). The compressive strength is more than 30 MPa at 28 days, that can reach the target in the project. We can see that the range of HRWR content from 0.2% to 0.3% doesn't influence on compressive

strength on compacted sub-grade. So that the water to cement ratio chose, $(W/C = 0.50)$ is suitable.

5.7. The effects of the admixtures on capillary pore and saturated absorption of mortar

The capillary pore and saturation absorption of mortar are given in Table 10

Table 10. The capillary pore and saturated absorption of mortar

N^o	WT_{dry}	$WT_{saturated}$	$\frac{WT_{saturated}-WT_{dry}}{WT_{dry}}100$	Capillary pore
	(g)	(g)	$\%$	$\%$
Control	570.2	591.0	3.65	8.2
1	567.0	582.7	2.77	6.2
2	563.2	577.7	2.57	5.8
3	577.3	589.5	2.11	4.8
4	553.7	568.5	2.67	6.0
5	566.8	583.0	2.86	6.4
6	571.7	583.5	2.06	4.6
7	575.2	588.8	2.36	5.3
8	546.2	561.0	2.71	6.1
9	553.7	566.8	2.37	5.3
10	552.7	564.3	2.10	4.7
11	554.8	570.2	2.78	6.3
12	564.7	577.3	2.23	5.0

Note: WT_{dry}, $WT_{saturated}$ are weight of dry and saturated specimens, respectively.

The effects of the admixtures on the saturation absorption of mortar are represented by Eq. (14)

$$D_s = 2.49 - 0.02X_1 - 0.07X_2 - 0.02X_1^2 - 0.03X_2^2 + 0.09X_1X_2 \qquad (14)$$

where: D_s is the saturation absorption of mortar; X_1 and X_2 are the coded variables

Note: In comparison with the control specimen, the capillary pore of specimens with admixtures is lower about 20% to 40%. Therefore the presence of polymer and HRWR in mixed mortar increases its watertightness (see Table 10).

5.8. The effects of the admixtures on the length change of mortar bar

The length change of mortar bar is measured in compliance with [7]. The specimens are casted and cured in the humidity of 80% and temperature of 25 ± 2^oC (condition in Vietnam). Symbol M_0 relates to specimen without admixtures; M_1 relates to specimen containing 3% polymer acrylic and 0.3% HRWR. The results of the length change of mortar bar for some given ages are represented in Table 11 and Fig. 2.

After 28 days, the shrinkage of control mortar (M_o) is 0.41%; this result is complied with some other research results [8, 9, 10]. In that time, the specimen containing 3% polymer acrylic and 0.3% HRWR (M_1) has the shrinkage of 0.06% that is very small. Thus, the adhesion to parent mortar of the mortar containing admixtures (polymer and HRWR) is higher than that of the mortar without admixtures. So that, the polymer acrylic

Table 11. The length change of mortar

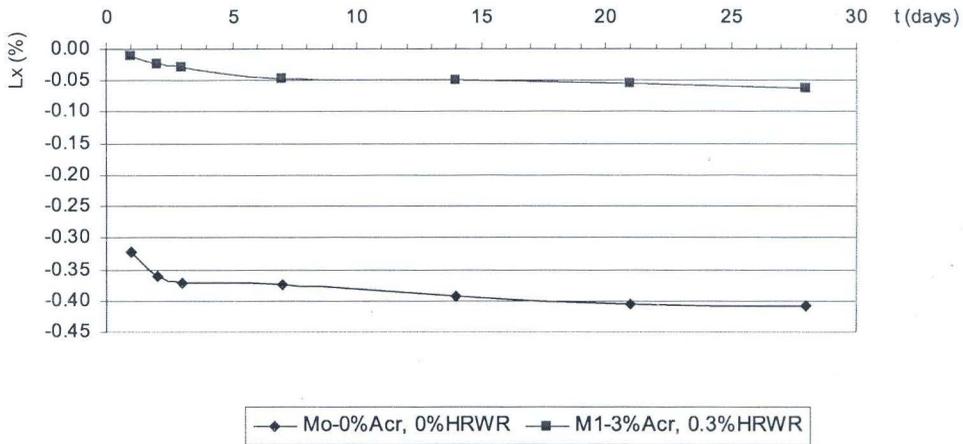| Given ages	Length change ΔLx (%)	
	M_0	M_1
1	-0.3235	-0.0115
2	-0.3626	-0.0241
3	-0.3722	-0.0286
7	-0.3757	-0.0469
14	-0.3931	-0.0503
21	-0.4052	-0.0559
28	-0.4087	-0.0628

Fig. 2. The length change of mortar bar

and HRWR are important for the manufacturing mixed mortar having high compressive strength and low shrinkage.

5.9. The results of watertightness of mortar

The watertightness of mixed mortar is tested as prescribed in [4]. Prismatic mortar specimens with 150×150 mm cross section and 30, 40, and 70 mm thickness are prepared for measurements watertightness. After 28 curing days in standard condition, the specimens are tested on the Matest machine with 0.4 MPa/cm^2 pressure. To maintain the time for specimens in 24 hours for 30 mm thickness, 48 hours for 40 mm thickness, and 78 hours for 70 mm thickness; the specimens are not permeable. So that, the mixed mortar has high watertightness.

6. PUT FORWARD THE CHART FOR MANUFACTURING TECHNOLOGY AND CONCLUSION

6.1. Issue chart for manufacturing technology

Dry mortar is packed the cement bag, each bag weight 15 ± 0.5 kg.

The proportion of mortar by weight is C : S : Polymer : HRWR = 1 : 3 : 0.03 : 0.003. The chart for manufacturing technology of dry mixed mortar as shown below

River sand	Cement PC-40	Polymer acrylic	HRWR
Container silo	Container silo	Container silo	Container silo
Sieve to reject the grains size > 5 mm	Determine the amount	Dosage (2%-3% cement)	Dosage (0.2%-0.3% cement)
Oven dry			
Cooling			
Container silo			
Dosage			

Mixing and package

Storage
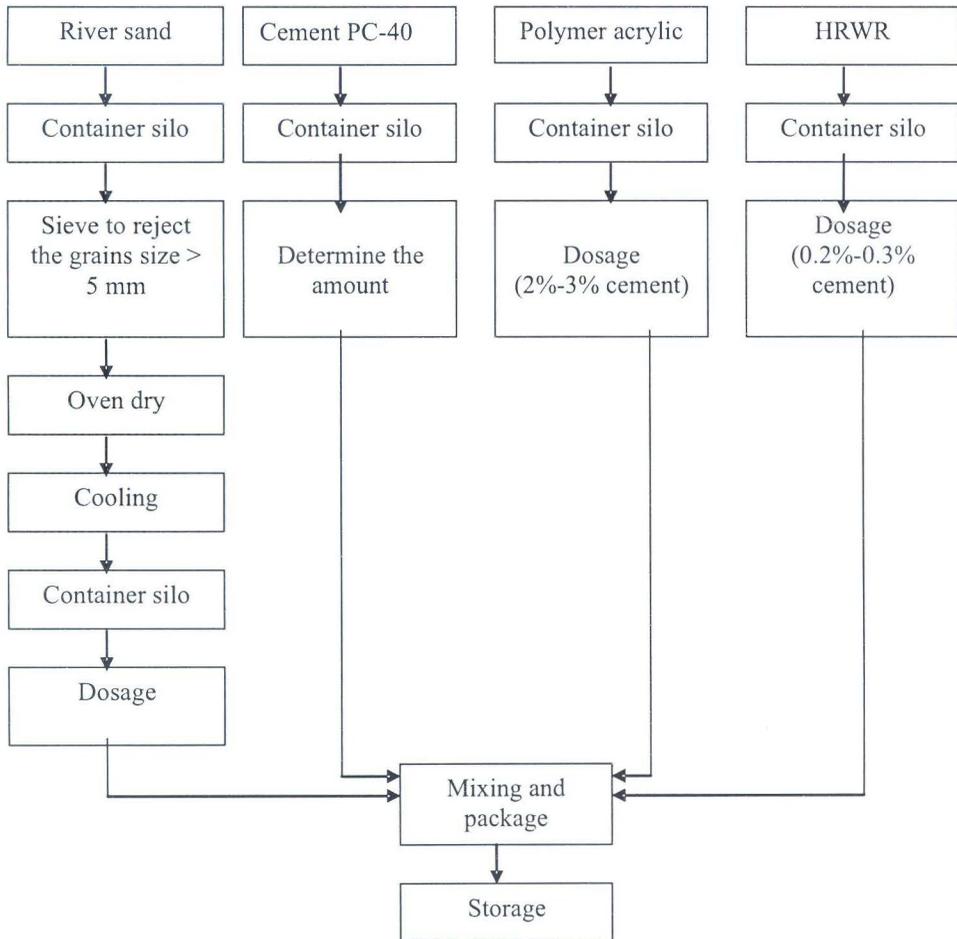
6.2. Main conclusions

1. The presence of polymer and high range water reducing admixture with researched range don't affect the setting time and workability of mortar.

2. With water to cement ratio $W/C = 0.5$, the compressive strength of mortar is more than 40 MPa. It is suitable for high strength mortar for restoration of hydraulic structures.

3. The presence of polymer and high range water reducing, exercises small the influence to flexural strength, the compressive of mortar on the compacted sub-grade.

4. The mortar with polymer and high range water reducing admixture increase the adhesion strength and watertightness of mortar.

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NGHIÊN CỨU SẢN XUẤT VỮA KHÔ TRỘN SẴN CÓ CƯỜNG ĐỘ NÉN VÀ CƯỜNG ĐỘ UỐN CAO, CO NGÓT THẤP VÀ CHỐNG THẤM TỐT DÙNG TRONG SỬA CHỮA HƯ HỎNG CÁC CÔNG TRÌNH THỦY LỢI CỦA VIỆT NAM

Sử dụng các vật liệu thông thường để sản xuất vữa trộn sẵn là rất cần thiết cho sửa chữa các công trình thủy lợi ở Việt Nam. Nó sẽ tiết kiệm được vật liệu và giảm giá thành của vữa. Trong nghiên cứu này, chúng tôi đã sử dụng xi măng sản xuất tại Việt Nam (xi măng Chinfon-Hải Phòng), cát tự nhiên (cát sông Lô), polymer Acrylic và phụ gia giảm nước bậc cao của công ty SIKA với tỷ lệ: 1 : 3 : 0.03 : 0.003 theo khối lượng. Tỷ lệ nước/xi măng là 0.5 luôn luôn đảm bảo cường độ nén của vữa lớn hơn 40 MPa, vữa có độ co ngót thấp, chống thấm tốt và độ dính kết cao. Vữa đó phù hợp cho sửa chữa các công trình bê tông nói chung và các công trình thủy lợi nói riêng của Việt Nam. Vữa khô trộn sẵn được sản xuất và đóng bao với khối lượng 15±0.5 kg.