Concrete Lining Pathology for Bleeding: Penstock and Surge Tank of Upper Gotvand Dam

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***Abstract*—Several problems involved with concrete excess bleeding, such as durability and strength mitigation, unsightly surface, delayed finishing or postponed mold translocation. The purpose of study is to detectmajor cause for excess bleeding in Gotvand affiliated projects.Thus, interaction among different ingredientswas surveyed viaslurry mixes. That way the most consistent components and subsequently appropereiate mixes were emerged . Besides that some alternative treatments were proposed as well.Then sort of physical model was devised to evaluate bleeding rate and capacity for each alternative mixes.**

Chemically inconsistent behaviorof components, poor fine content, nonuniform cement manufacturing have beeen recognized as major motives. Bringing stone powder back to sand production cycle was concluded as an effective as well as most economic treatment option.

Concrete placement into segment through mere one access point at each elevation of formwork, thus unfavorable concrete displacement using formwork vibrators was identified as the most harmful executive cause as well.

***Index Terms*—Alternative treatments, bleeding, components' interaction, physical model.**

I. Introduction

Fresh concrete is an unstable suspension of binder and aggregate. With time, thesesolid particles settle, causing an upward migration of water towards the top surface [1], which is called bleeding, also referred to as water gain, weeping, and sweating in some countries.

Bleeding isn't always bad. It lowers water-cement ratio and densifies the concrete. Small amount of bleeding is normal and expected on freshly placed concrete and does not necessarily have an adverse effect on quality of plastic or hardened concrete [2]. However, concrete that bleeds too fast or too long can cause a number of problems: rock jams in pump lines; streaks in walls, weak horizontal construction joints,and harms to self-curing capacity and final strength,as well as voids beneath rebar and aggregate particles. Concrete durability loss is another evil. In normal bleeding clear water rises upward uniformly, but in channeled bleeding water rises upward by vertical channels, carrying fine particles to the surface. When latter occurs, bleeding rate rises and a layer of slurry can be seen on the top surface just beneath bleed water, thus damages would be more sever [1]. Measurement of bleeding isan indicator of concrete overall quality.

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Johnson L. J. had made lecture notes on engineering.

Materialsand had surveyed concrete bleeding, during stadium construction at Harvard University (1926).

Cement bleeding and its influence on concrete properties had already been investigated as well by Mardulier F. J. (1967). Making use of cement supplemental materials such as Fly ash or Ground granulated blast furnace slag has been studied, like that of done by Gebler S. H. and Klieger P. (1986). R. S. Ravindrarajahhad concluded that bleeding capacity is increased when cement replacement level with fly ash increases.Blended cement with slag act similarly as well. Conversely, 30 to 40% addition of fly ash reduces bleeding capacity.

Influence of bleeding on minute properties of concrete was investigated by Melito A. Baccay and et al. (2004). Viscosity modifying admixtures and cellulose fibers as beneficial options has been explored by various scholars and results were reported. Guideline issued by EFNARC in cooperation with EFCA at 2006 is an example report.

To evaluate each alternative, bleeding measurement is essential.

First group of methods, measure the amount of bleed water, whereas second group is measuring particle settlement [1]. An apparatus has been applied by Sawaide and Iketani in which a liquid denser than water was applied to separate bleeding water from cementitious materials. L. Josserand and F.de Larrard had used three molds with different initial heights. And then bleed water had been sucked up of central part of tracks made on top layer of samples.

Gotvand Dam, the largest rock fill dam located in southwestern Iran sporadically experiences too bleeding in its affiliated projects such asconcrete lining of pressure tunnels andsurge tanks.

Each concrete ingredients as well as executive methods could be a capable cause. However no distinct triggers could be discriminated at first, thus each probable stimulant should be assayed. Afterinteraction of paste ingredients to be tested via slush grout mixes [3] and inconsistent behavior of some components were detected; alternativeconcrete mixes were placed in a mold thatphysically models heading form heel and its upper load. This model providesvirtual records of bleed water that leads us to bleeding capacity and bleeding rate as well.

Differentaggregate sourcesavailable with manipulated fine contents were applied to check whether if the options how much influence the disease.

Sand powder, viscosity modifying admixtures (VMA) or matrix cellulose fibers astreatment proposals were tested as well.

Restricted native sources available of Natural Pozzolans, Fly ash, Ground granulated blast furnace slag or other concrete supplemental [4], no uniform production pertaining to their regulatory agents, as well as financial considerations for overseas provision, made us to find the way through convenient mix components.

Certainly plasticizer replacement by a super plasticizer reduces W/C ratio and bleeding subsequently [5].

As it has been predictable, bringing back rod mill stone powder slurry to sand production cycle is essentially profitable and Pozzolith LD21 is revealed the most consistent plasticizer in conjunction with cement sources.

II. Method

Taking advantage of high performance concrete has become inevitable to make most constructions efficient. Surely high W/C ratio is the most essential cause of bleeding and other numerous known evils. Thus plasticizer and super plasticizer employment have already been our trend to keep W/C ratio low enough, around 0.41.Occasional occurrence of bleeding, in spite of constant W/C ratio, leads us to speculate of causes other than mere W/C ratio. That way some primary hypothesis for excess bleeding was proposed;

1) Chemically inconsistent behavior of water supply and chemical agents of cement sources.
2) Since Bleeding periods mostly concurred rainy seasons, thus there might be some motive ions or agents washed away of upstream Geotechnical formations into Karoon, the River on which Got and Dam is constructed and water demand is supplied.
3) Incompatibility of applied admixtures with cements or water sources.
4) Poor, no uniform quality of cement production and resulting changes in their analysis, chemically or physically.
5) Presence of excess water or deficit of fine content in mix design.

To investigate the above mentioned hypothesis, five in use cement sources, eight admixtures, and four water sources were evaluated [6]. Aggregate, particularly fine materials were studied as well.

Karoon, Ilam, and Behbahan among type 5 and Ramhormoz, and Shahrecord among type 2of Portland hydraulic cements are available sources for construction.

Pozzolith LD21, a plasticizer and Gleniume 51P, a super plasticizer produced by BASF, Plast209N a plasticizer and Optima 250 and 270 super plasticizers of Cryso Company, Conplast RP264M of Fosroc, and WR-31 as well as CP-WRM products of LG were used to figure out what effect admixtures might have.

To control water quality influence, we planned to use distilled and mineral water as well as laboratory and batching plant water sources in experimental slush grouts.

It is notable that lignosulfunate and polycarboxilate are chemical basis for applied plasticizers and super plasticizers respectively.

After concrete ingredients and their interaction were explored, alternative mix designs have been evaluated for bleeding rate and capacity, using physical model.

A. Cement-Admixture-Water Sources

To make analogies of different sources, some monthly average peculiarities at 2010 is presented (see Table I- Table Ш).

Slurries are efficient tools to probe cement, water, admixture interactions. General mixes for slurries are shown Table I.

Using mentioned ingredients, alternative slurry mixes were developed and some leading attributes were measured, including density, marsh funnel, 3-hours bleeding(settlement), initial and final setting, and compressive strength (see Table II-Table Ш).

TABLE I: Average Physical Traits, Karoon Cement

Samp.	Blain (Cm/gr)	Com.Stren.(MPa)			Setting Time(Min.)		Autoclave (%)
		3-days	7-days	28-days	Initial	Final	
June	3282	16.8	21.5	30.2	105	143	+8
July	3237	15.2	20.2	28.4	105	147	+2
Aug.	3221	14.1	19.7	26.7	94	134	+4
Sep.	3097	12.6	17.6	23.4	113	140	+6
Oct.	3124	14.8	19.3	24.6	130	157	+5
Nov.	3169	11.5	14.9		153	193	+6

TABLE II: Average Physical Traits, Ilam Cement

Samp.	Blain (Cm/gr)	Com.Stren. (MPa)			Setting Time(Min.)		Autoclave (%)
		3-days	7-days	28-days	Initial	Final	
June	3653	21.1	26.9	36.1	83	121	+2
July	3510	22.4	28.2	37.9	98	143	-5
Aug.	3473	20.4	25.1		118	155	- 8
Sep.	3443	19.7	25.4	32.8	112	150	-1
Oct.	3505	18.7	23.4	25.5	113	144	+1
Nov.	3708	18.8	24.3		118	156	+2

TABLE III: Average Physical Traits, Behbahan Cement

Samp.	Blain (Cm/gr)	Com.Stren. (MPa)			Setting Time(Min.)		Autoclave (%)
		3-days	7-days	28-days	Initial	Final	
June	3020	15.6	19.8	26.7	145	185	+5
July	3052	15.3	21.2	31.2	149	193	0
Aug.	2887	14.4	19.5	25.5	167	223	- 2
Sep.	2850	13.3	16.3	19.5	203	263	+3
Oct.	2984	15.0	18.3	23.3	148	180	+3
Nov.	3002	14.2	19.1	20.9	159	197	+2
Dec.	2998	9.2	14.0		172	217	+8

TABLE IV: General Mix For Cement Slurries

Admixture Type	Dosage (%)	Cement Content(kg/m3)	W/C Ratio(-)
Control(Adm. Free)	0.0	380	0.41
Plasticizer	0.75	380	0.41
Super Plasticizer	0.5	380	0.38

Elicited Information of following tables reveal that changes made in water ions and elements could influence physical attributes of fresh concrete, thus probable changes in bleeding behavior are expected subsequently (see Fig. 1 and Fig. 2). Nevertheless slight observed differences among distilled water made and other water made slurries with information available at this step, aren't evidence enough to proof of first or second hypothesis.

Fig. 3-Fig. 5 illustrate example behaviors to investigate probable incompatibilities among cement and admixture sources.

Varying observed interaction of different sources make the idea more certain that, chemical inconsistencies among applied cement and admixtures could be a leading cause, thus third hypothesis might be true.

Capability of taking advantage of two in site laboratories, Sepasad Company and Road Ministry make it possible to check whether if input raw materials have proper and uniform qualities or not.

TABLE V: CEMENT-WATER-ADMIXTURE, KAROON SLURRIES

Cement	Slurry Mix		ρ(gr/cm3)	Marsh Funnel(Sec.)	3H-Bleeding(%)	Initial-Setting (Min.)	Final-Setting (Min.)	Ave.Com.Stren. 7D.	Ave.Com.Stren.2 8D.
Karoon	Water-Admixture Free	Mineral	1.97	133	2.0	380	485		
		Distilled	1.94	183	1.7	365	445	34	
		Lab.	1.94	192	1.9	350	420	33.1	
		Batching	1.94	132	1.8	355	440	33.8	
	Lab W.+0.75%plasticizer	Pozzolith	1.90	64	0.5	1088	1155	26.4	42.1
		Conplast	1.91	49	0.5	>4320	>4320	28.2	41.8
		Plast209 N	1.92	51	2.5			27.4	56.7
		WR-31	1.87	53	0.5			27.9	47.3
	Lab W.+0.5%Super plasticizer	Gelenium	2.0	52	1.5			39.7	60.6
		Optima250	2.0	64	2.0-2Phased			44.2	63.1
		Optima270	2.0	73	1.5-2Phased			39.5	55.1
		CP-WRM	2.0	50	1.5-3Phased			45.3	81.4

TABLE VI: CEMENT-WATER-ADMIXTURE, RAMHORMOZ, SHAHRECORD, AND ILAM SLURRIES

Cement	Slurry Mix		Density (gr/cm3)	Marsh Funnel (Sec.)	3H-Bleeding(%)	Initial-Setting(Min.)	Final-Setting (Min.)	Ave.Com.Stren.7D.
Ramhormoz	Lab.W+ Plasticizer	Pozzzolith	1.91	53	0.3			27.2
		Conplast	1.93	52	0.6			24.8
	Lab.W.+Super Plast.	Gelenium51P	1.99	58	3.0			33.4
		Optima250	1.99	67	3 (2Phased)			31.3
Shahrecord	Lab W.+Plast.	Pozzzolith	1.93	90	0.4	>4320	>4320	2.8
		Conplast	1.93	70	0.5	>4320	>4320	1.1
	Lab.W+Super P.	Gelenium51P	1.99	104	1.0	735	845	44.2
Ilam	Lab. W+Plast.	Pozzzolith	1.90	50	1.3	880	985	35.7
		Conplast	1.93	51	1.3	1220	1440	38.7
	Lab. W+SuperPlast.	Gelenium51P	2.0	64	3.2	880	1045	46.5
		Optima250	1.99	70	(3Phased)	765	840	51

Regular calibration commitment of tools, accompanied by perfect inspection on staff expertise, makes parallel measurements more accurate and reliable.

Since higher blain values usually decrease bleeding intensity, it can be concluded that Ilam cement is much more beneficial to relief the disease. In contrast Behbahan makes concrete more vulnerable to high bleeding rate or capacity Fig. 6.

Since measurements of both laboratories are corresponding each other for Ilam cement shipments at September, its regular and uniform production is concluded. Conversely Karoon and Behbahan cargoes vacillate appreciably, thus make problem more complicated.

As we know longer setting time makes bleeding more likely to exacerbate [7]. Therefore, more bleeding is expected of Behbahan and Karoon and the least, of Ilam usage (see Table I-Table III).

Limited at our disposal data of chemical agents, aren't evidence enough to proof of fourth hypothesis.

Chemical analysis of cement sources reveals almost no abnormal chemical agent content, except for total alkalis, that is normally below 0.6%. For instance be hbahan and Karoon samples have averages of about 0.78 and 0.80% respectively.

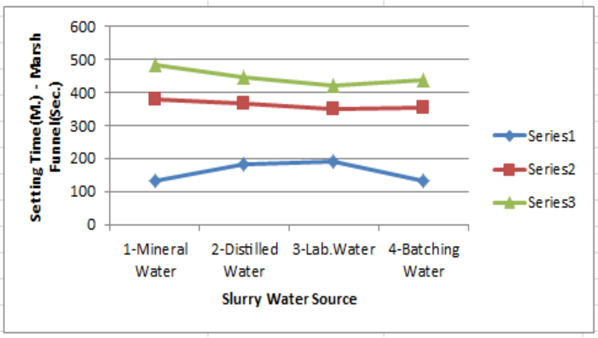

Fig. 1. Karoon cement, initial and final setting, marsh funnel.

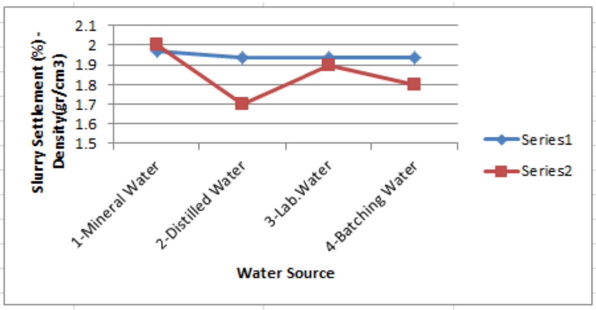

Fig. 2. Karoon slurries, density and 3-H. bleeding.

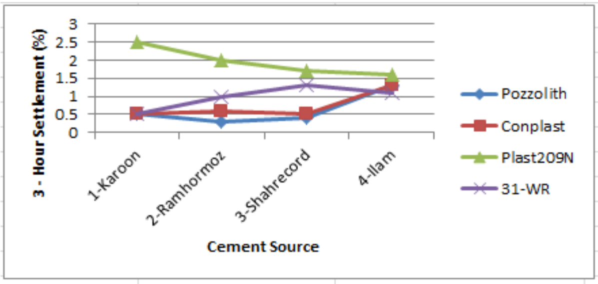

Fig. 3. Cement–plasticizer slurries, 3 hour bleeding.

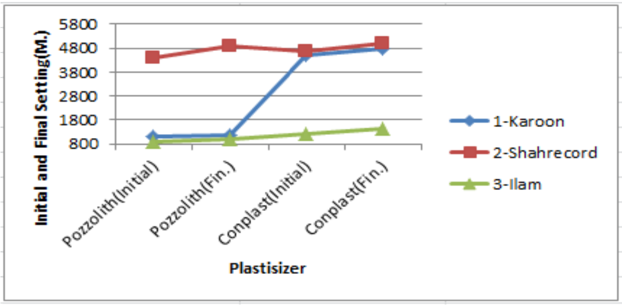

Fig. 4. Cement–plasticizer, setting times(minute).

Nevertheless free $CaCo_3$, MgO, SO_2, and C_3A content of cements couldn't be blamed for fresh concrete bleeding with certainty.

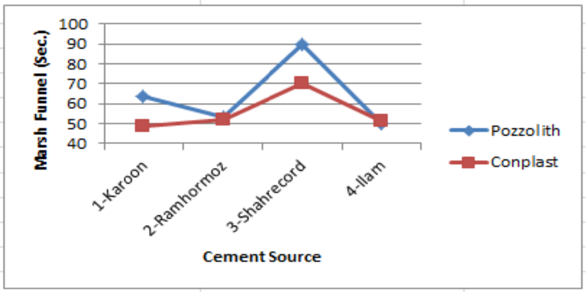

Fig. 5. Cement–plasticizer, marsh funnel.

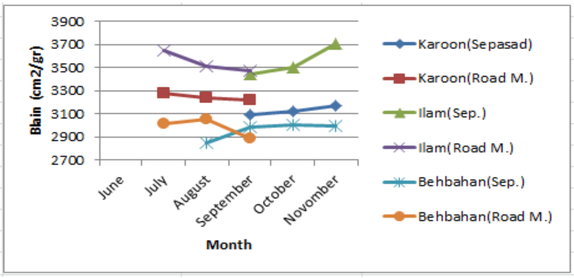

Fig. 6. Average measured blains in two laboratories.

B. Aggregate Survey

Studies indicate that poor moisture control ofsandalong with sporadic deficits available in moisture sensors of batching plant exacerbate bleeding occurrence. In cold seasons, rain fall increases their moisture content and there is no need for aggregate cooling to make water content partially evaporated. In contrast less moisture content available in hot weather is about to evaporate to make material temperature to decline. Besides that high evaporation rate in hot season, mostly balance bleeding rate, thus no excess water appears on the surface [8].

Numbers of qualitative peculiarities for employed river gravel and sand materials could be seen here in (see Table VII and Table VIII) It is important to say aggregates have already checked chemically using ASTM standards, including alkali reaction, and etc. Physical traits of gravel are normal except for elongation coefficient that exceeds assigned limitation. Table III Shows kind of qualitative recession for procured sand.

TABLE VII: QUALITATIVE PHYSICAL ATTRIBUTES FOR RIVER GRAVEL

Row	Test Title	Size(5-9.5)mm	Size(9.5-19)mm
1	Real Density(gr/cm3)	2.642	2.642
2	Bulk Density(gr/cm3)	2.707	2.700
3	Saturated Surface Dry D.	2.666	2.664
4	Water Absorption (%)	0.9	0.82
5	ElongationCoefficient(BS-818)	-----	35.1
6	Flakiness Coefficient(BS-818)	-----	20.1

TABLE VIII: QUALITATIVE PHYSICAL ATTRIBUTES FOR RIVER SAND

Row	Test Title	Oct.01, 2010	Dec.08,2010
1	Passing # 200 (%)	5.4	2.8
2	Real Density (gr/cm3)	2.578	2.519
3	Bulk Density(gr/cm3)	2.682	2.645
4	Saturated Surface Dry Density-SSD(gr/cm3)	2.616	2.568
5	Water Absorption (%)	1.5	1.9

III. CONCRETE BLEEDING MEASUREMENT

To check whether if any proposed option for concrete lining of penstock and surge tank is beneficial or not, it is of utmost importance to provide correct as well as accurate enough data. To make experimental data much more correspond to real condition,heading formwork at heel and casted in concrete was physically modeled to simulate procedure and the load upon which, concrete undergoes initial and final settings (see Fig.7).

Formwork is used for lining of heading segments at 11 meters diameter penstock. Since benching segment has 1.15m depth and height of model is about 1.20m, thus a column of concrete in 8.65m height compresses heel concrete vertically. We can calculate the load upon which concrete bleeds (Eq. (1) and (2)).

σ, Z, ρ, g, F, and A in (1), (2) are normal stress, volumetric weight of concrete, concrete overload height, volumetric mass of concrete, normal(vertical) force, and the area on which normal stress is exerted, respectively.

Kind of (0.3×0.3) m2 steel plate is used to transmit normal force onto fresh concrete, procured by a hydraulic jack.

Fig. 7. Form modelat heel, vibrator and concrete loading.

To make experimental loading closer to actual casting schedule, normal force was started to implement after 60 minutes of placement in model, and gradually grows during next 60 minutes to its ultimate value, (1), (2).

$$Z \rightarrow \sigma = \rho g z = 2380 \times 9.81 \times 8.65 = 201958.47 \quad (1)$$

$$F = \sigma.A = 201958.47 \times (0.3 \times 0.3) = 18176.26 \text{ N} = 1852.83 \text{ kg} = 1.853 \text{ Tons} \quad (2)$$

Model volume is about 107 liters. After concrete placement and loading, bleed water leaks and is sucked up using a pipette. That way practical bleeding capacity could be measured and bleeding rate with time could be essayed as well (see Fig. 8) This would be more accurate than that of elicited of small concrete specimen [8].

Besides that hardened concrete face can be observed for every probable flaw like sand streaks, laitance, etc.

IV. Treatment Alternatives

A. Rod Mill Sand – (0-3)mm

Our spillway contractor produces its aggregate demand using rod mill and hydro cone systems.

Fig. 8. Gathered bleed water for an alternative concrete mixdesign.

Partial replacement of (0-5) mm river sand by (0-3) mm rod mill produced materials has been an option. A mixture of two sand supplies in 50/50 proportions was applied atour basic concrete mix design, RT1 (see Table IX).

Bleeding behavior was monitored by the privilege of fabricated model. Observations illustrate that it didn't act effectively to absorb excess free water in fresh concrete.

TABLE IX: Basic Mix for Concrete Lining

Mix Name	W/C Ratio	Cement -kg/m3	Admixtu(%)	Aggregate(%)			Slump (cm)
				(0-5)	(5-9.5)	(9.5-19) mm	
RT1	0.41	350	0.65% PozzolithLD	45	10	45	18

TABLE X: Revised Mix by 5% Stone Powder

Mix Name	W/C Ratio	Cement (kg/m3)	Admixture (%)	Aggregate(%)				Slump (cm)
				Stone Powder	(0-5) mm	(5-9.5)	(9.5-19) mm	
TB6	0.46	380	0.75%Pozzolith LD21	5	45	15	35	18

TABLE XI: Revised Mix by Super Plasticizer

Mix Name	W/C Ratio	Cement (kg/m3)	Admixture (%)	Aggregate(%)			Slump (cm)
				(0-5)	(5-9.5)	(9.5-19) mm	
TB7	0.38	380	1.2% Gelenium 51P	60	10	30	19

TABLE XII: Revised Mix By VMA

Mix Name	W/C Ratio	Cement (kg/m3)	Admixture(%)	Aggregate (%)				Slump (cm)
				(0-3)	(0-5)	(5-9.5)	(9.5-19)	
TB8	0.45	350	0.75%Pozzolith LD21+0.25%VMA	14	31	15	40	19

TABLE XIII: Revised Mix by Super Plasticizer

Mix Name	W/C Ratio	Cement (kg/m3)	Admixture (%)	Aggregate(%)			Slump (cm)
				(0-5)	(5-9.5)	(9.5-19) mm	
TB7	0.38	380	1.2% Gelenium 51P	60	10	30	19

TABLE XII: Revised Mix by VMA

Mix Name	W/C Ratio	Cement (kg/m3)	Admixture (%)	Aggregate (%)				Slump (cm)
				(0-3)	(0-5)	(5-9.5)	(9.5-19)	
TB8	0.45	350	0.75%Pozzolith LD21+0.25%VMA	14	31	15	40	19

TABLE XIII: UF500 Involved Mix and It's Control

Mix Name	W/C Ratio	Cement (kg/m3)	Aggregate(%)			Adm./Additive (kg/m3)		Slump (cm)
			(0-5)	(5-9.5)	(9.5-19)	Pozzolith LD21	UF 500	
TB9	0.41	350	45	15	40	0.75% (2.625)	0.0	19
TB10	0.45	350	45	15	40	0.75% (2.625)	0.43 % (1.5)	18

B. Stone Powder

Rod millproduces stone powder slurry that is taken away and deposited at certain pools (see Fig. 9) stacked particles are extremely fine content including materials with 98% finer than 0.075mm. RT1 was revised by 5% stone powder usage. It reduces performance, so that despite enhancement made in cement and plasticizer content, initial slump was mitigated to 5cm (see Table X). To compensate performance loss, W/C ratio was increased to 0.46. Nevertheless, data records demonstrate remarkable Influence to relief excess bleeding (see Fig. 10). Bleeding capacity and initial bleeding rate for RT1 were measured 550 ml and 230ml/h respectively. Since model volume is about 107 liters, it can be concluded, its bleeding capacity is almost 0.5% of total concrete volume. Whereas initial bleeding rate and capacity for TB6are70ml/h and 114 ml. It is evident; this convenient additive is highly beneficial as a rod mill by-product without any expense.

Fig. 9. Rod mill – produced Stone powder

Model size as well as satisfactory condition to allow water leaks out of the sample provided by one side rabitz, make itpossible to measure whole bleed water.

Concrete volume of heading lift for an 11 metersblock is about 143 m3, thus total bleeding water of nearly 715 liters is expected. Since 130 to 160 liters of water comes out of placed concrete and almost 140 liters might be absorbed by surrounding shotcrete, probable water volume around 400 liters is confined inside concrete lining. Bleeding hazards, briefly outlined at introduction, mostlyderived of such restricted excess water.

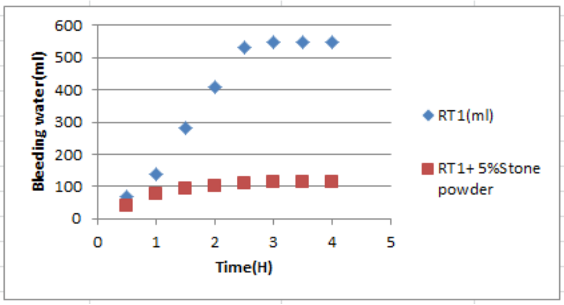

Fig. 10. Stone powder usage – bleeding rate and capacity reduction

C. Super Plasticizer Application

Plasticizer replacement by a super plasticizer is a regular method to decrease W/C ratio and excess free water subsequently. However its higher cost is unfavorable, thus more convenient and less cost additive or admixtures has been more ideal. Nevertheless Gelenium 51P as our most consistent super plasticizer was used to make mix design, bleeding resistant.

We put forth W/C = 0.38 in comparison with 0.41(Plasticizer related one) as our primary assumption to determine other required changes (see Table XI).

TB7 was practically employed for benching section of a block. It reduces bleeding considerably, but to acquire similar performance we had to raise cement and admixture contents to 380 kg/m3 and 1.2 % respectively. On the other hand large bubbles appear on the surface of fresh concrete that produce laitance and damages surface quality. Therefore another existing option was followed.

D. VMA Usage

To observe VMA (viscosity modifying admixture) behavior [9], RT1 was revised with 0.2, 0.25, and 0.3% VMA content. TB8, 0.25% VMA involved mix could be seen (see Table XII).

Although W/C ratio increases to 0.45, VMA was capable of retaining excess water into the paste homogenously, and then bleeding descend considerably.

However rapid slump loss has occurred, so that it drops from19 to 13 cm during 15 minutes. It is considered as a practical obstacle, particularly at widespread embankment dam workshops and distant concrete casting locations.

E. Matrix Cellulose Fibers

Matrix UF500 is the last additive that was tested in mentioned period (see Fig.11)..

It is contended that this additive enhances compressive strength, durability characteristics and water absorption capacity as well [10]. Thus, a UF500 involved mix was devised, so that the same performance as RT1 was acquired (see Table XIII).

107 liters, model placed concrete shows that bleeding has been diminished, so that 325 ml total bleed water was gathered, compared to 550 ml for RT1.

It is notable that UF500 acts relatively slight to cure the disease and increases required W/C ratio as well.

Therefore it didn't practice at field.

Fig. 11. Matrix cellulous fibers, UF 500

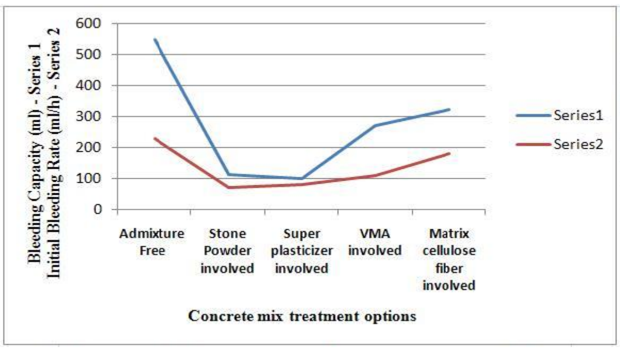

Fig. 12. Bleeding analogies for different alternative treatments.

Each individual treatment has specific effect (see Fig. 12). As we mentioned at corresponding sections, each behavior may negatively sway positive effect showed by relevant agent and make the option out of order such as rapid performance loss for VMA or laitance appearance in case of super plasticizer.

To provide analogies, bleeding capacity and initial bleeding rate are shown for treatment options (see Fig. 12).

As it is mentioned before bringing produced stone powder back to sand production cycle is recognized, the most economic and an effective option as well.

V. Conclusion

After experimental tests accompanied by executive observations were conducted, Recommendations were developed to compensate or at least to minimize excess bleeding demolitions:

1) Formwork access points at each elevation should be increased in number, to adapt concrete displacement needs with respective ordinances.
2) With current state of admixture, designed W/C ratio and subsequently resulted in slump has to be declined, thus numbers as well as work duration of formework vibratores have to be modified to compensate performance loss.
3) Plasticizers couldbe replaced by superplasticizers to reduce W/C ratio, ofcourse financial affairs as well asperticular behaviour of each product should be considered.
4) Among Plasticizers that we have access on, Conplast RP264M actinconsistently with Karoon,Shahrecord, and Ilam cements. In contrast Pozzolith LD21 has the most agreement with other ingredients. It has been producing uniformely as well.
5) Making use of cement products, characterized by higher blain and lower setting times will resulted in declined seperated water.
6) Target mix design have to be revised for each alternative cement-admixture couples.
7) Sand qualitative reccession and its low filler content(<0.075mm) in certain periods, could influence bleeding.
8) Ultrafine materials(stone powder)in aggregate producing cycle should have to be retained, as an economic and efficient cure (Despite W/C ratio growth).
9) To bring W/C ratio back close to its former value in order to prevent relevant evils including mechanical as well as durability hazards, it is necessary to enhance admixture dosage a little bit in case of stone powder.
10) VMA and matrix cellulose fibers aren't favorable for Gotvand Dam, but could be ranked asmoderate absorbants at workshops with convenient placement locations or less bleeding involved sections respectively.
11) It was revealed, schedule deficiencies to procure cement demand,brought about ofeither sanction originated restrictions for production or imperfect internal management, caused different input cement sources to be stacked at same reservoires.
12) Qualitative flactuations, discriminated among different sources even at shipments of individual certain sourcesillumintes the importance of seperately stacked cements of defferent sources, even at each production period.

As we all know, previous studies indicate that:

13) Each pozolan source regarding its specific attributes have to be tested to check whether if it influences the disease or not.
14) Microsilice absorbs water highly. But it has to be noticed that decreases performance significantly. That way its application is limited to some certain structures.

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