



The Effect of Portland Cement on Fly Ash Bottom Ash Geopolymer Hybrid Concrete Exposed to Peat Water Environment

T zytff V wtdl 5. OYfio Zl fRA WRA x l 5OMPRA h l Yl ffr NtR 5OPH yol RAZ x p Ztff x " fiw0 Hwly Rlx l wot 5ONfiyl ftly b tntfyz 5OLO Zl " fifRA

5 Kp" l RA pyffz qj tftwLyr typpRAr OM nfiwf z qLyr typpRAr 0] ytlpRiff TH d fiOVpvl ynl R6=6 (@0Ry ozy pTh 6 Kp" l RA pyffz qj s px tnl wLyr typpRAr OM nfiwf z qLyr typpRAr 0] ytlpRiff TH d fiOVpvl ynl R6=6 (@0Ry ozy pTh

HI Z [J [ANpz " zwx pRA nRA nznRpf tTh RA l RA m l nffil ffr l Thnz zx l Thftff ly lwl wtp Thdffzy l yo nfiRA ftff VRAyl RAWRAyo J px pyff, VVJ - 2VVJ nznRpf npl oopo ff px tttfRAE tynRA Thff p RA nfnzy 0" RA z ff s oRAfzy 0l yo l Thffty nfiRA l fRA x fpx " pRA fRA Wl fffl fRA lhy lntotn z RA ytn pyffRA x pyffs l ffx l RA fimp ff p ofiRA tuff z qnznRpf 2 p " fiRA Th z q ff tTh RA tThE opfRA ty ff p p nffz q VRA yo npx pyffzy ff p " RA pRA Th q MHI Hrpz " zwx pRA nRA nznRpf ptt z Th ff " pl fffl fRA RA yo npx pyffl Th Th ty rpz " zwx pRA lhy l ootffl l yo l Th mThff ff 2] zx " RA Thp Th RA ff 0 " z RA ff Ol yo ft ptrs ffn l yrp ft pRA fl w l ffo q RA ff x tttfRA p UIVO x z wRA Th pRA 40560l yo 58T Of p UIVO 3 Thotfix Thnl ff RA z Th pRA 206240l yo 620l yo ff p VRAyl RAWRAyo J px pyff " pRA yff rp Th pRA 40540l yo 59) 2Z" pntx py Th pRA ptt z Th ff " pl fffl fRA RA ff @ ol Th z wfttyr 6= ol Th q RA x fpx " pRA fRA nfiRA 2 p rpz " zwx pRA tttfRA tff 54T UIVO 062 T Th yo 59) VVJ slo ff p strsp Thnz " RA Thp Th RA ff l yo ff p wftp Th z RA ff 2 p MHI Hrpz " zwx pRA nRA ftff VVJ slo l Th rs fvr RA fRA x " RA Thp Th RA ff l yo l wftp RA z RA ff ff l yo ff p rpz " zwx pRA z yff tytyr VVJ l Th npx pyff RA w npx pyff l fRA 2 Ry l ootffzy 0 ft ptrs ffn l yrp tTh z RA fimp ty rpz " zwx pRA z yff tytyr VVJ 2l l Th z y ff p " pRA l ynp z q n z ff x ttpTh " pl fffl fRA Th RA x x pyopo ff fi Th VVJ l Th l ootffl ty MHI Hrpz " zwx pRA nRA nznRpf 2 Rp ftz RA n ootffl p 0 l Thnz zx l Th " pl fffl fRA RA yo npx pyff RA w npx pyff

1. INTRODUCTION

Npz " zwx pRA l RA " RA l RA m RA nfiyR Thnl l yo l vix tyl IRAs Th fRA x l fRA Wl tff ly lwl wtp l nffil fE RAS h2 Npz " zwx pRA RA pRA Th RA ty fipynp m ff p nspx tnl w n z x " z Th zy z q RA x l fRA Wl foz Th rpl yo ff " p z q l w wtp l nffil fE RA l ootffl Th yo ff p nfiRA " RA pof RA Kz Th r p z q lwl wtp l nffil fE RA l Th nRA w q RA ff p opfRA " x pyff z q ff p RA nfnzy mpftppy Thnl l yo l vix tyl 2 Ry ff p nl Th z q wft l " fil wff l Th 0 l x z wRA z q w Th ff ly 56T UIVO tTh RA x x pyopo f6h2 H Thnl ff nznRpy RA z y z q w Th ff ly 72 nzy fRA f ThE tx " RA ltyr z q ff p lwl wtp pyff RA x pyff l yo rpz " zwx pRA pftz RA f7h2

Tly Th otp Th yop RA y ff p yppo ff fi Th nfiRA l rpyffl Th ms l Th Th r l yo VRAyl RAWRAyo J px pyff, VVJ - l Th nfiRA " RA nfiRA RAE pyl nmp ff rpz " zwx pRA nfiRA fRA x fpx " pRA fRA 8 l h2 K fip ff ff p opfRA " x pyffz q J IHIZIO z RA J l wftix H fix tyz Z wnl ff O oRA fO ff p rpz " zwx pRA tyn w otyr ff z Th l ootffzy Th Th z x pff p Th RA pRA ff l Th rpz " zwx pRA nRA f; h2 p tyn RA RA z y z q VRAyl RA WRAyo J px pyff, VVJ - ty ff p rpz " zwx pRA Th p ty fipynp Th p Th RA ff x pnslytTh m tyn RA Th r ff p RA f z q RA nfnzy " RA ofinn RA fzy l yo ff p q RA l fzy z q ptt RA s oRA z y " RA ofinn ty ff nznRpf 2 Ry ff p rpz " zwx pRA Th p 0 ff p l ootffzy z q 9 l 64) VVJ nznRpf nsl yrp ff p s oRA z y " RA ofinn Th p RA to RA nfnzy z q rpz " zwx pRA fzy l yo ff p str s oRA z y " RA ofinn q RA VVJ pysl ynp ff p pl RA l rp Th Th RA ff z q ff p rpz " zwx pRA nRA 2 p rpz " zwx pRA nRA n z x ntypo ftff VVJ q RA l ty op RA p Th 2 J l, H- IZIO l yo J IZIO 3U IHIZIO fts tns tTh z RA x x " wttl yo sl Th ot pRA ff

n z x " z Th zy ff l yo ff p nzy fpyffz yl w rpz " zwx pRA, 0=h2 p tyn w Th ay z q ff p Th nty op RA p Th z " RA l Th p Th RA ff 0" z RA ff l yo ofiRA tuff z q ff p nznRpf 2

J l wftix l ootffzy ff ff p rpz " zwx pRA z ffzy w tx " RA l Th Th RA ff opfRA " x pyff nfiw wft pRA ff p nfiRA fpx " pRA fRA Z z x p fi Th VVJ l Th RA w npx pyff q RA l Th 0 fts tny z ff pRA fi Th o tffl Th l ootffl f90=154h2 wRA z fi Th fio tyotl ff Th ff fiffw tyr 54 l 59) l Th l Th Th mThff ff x l fRA nly tx " RA l ff p Th RA ff l yo opy Th z q ff p rpz " zwx pRA (h2 V ff pRA ot Th fl p RA ff l fffl Th r VVJ l Th l ootffl l nnpv RA po nfi RA " RA ofintyr l rpz " zwx pRA tff nzy Th p RA w str s pRA oRA z y ff l yo ff p RA w npx pyff 55 l 57 h2 p npx pyff ff l Th RA z tyotl ff Th ff l ff ff p npx pyff nzy fpyff sl Th yn RA Th o ftff ff p RA w npx pyff Oz ftp RA ff p ty fipynp z q VVJ zy ff p rpz " zwx pRA Th p RA fith RA Th RA l fiffzy ty ff RA z q ofiRA tuff 2 MIRA p RA z RA o ft ty fl Th l fzy Th zy ff p p nffz q VRA yo npx pyffzy ff p rpz " zwx pRA Th p sl fl p mpy RA z RA 2

WRA z fi Th otp Th Th r l rpz " zwx pRA nRA Th p x sl Th " RA z fi Th z fty ff l fff p Th p x tTh p l RA f l yo fyt" fip ofip ff ff p " RA p npx q fffz ot pRA ff Th p Th RA ff z q ff p rpz " zwx pRA nRA Th RA ff tThnz " l RA p ff ff l f z q ff p VVJ Th pntx py Th f9h2 Npz " zwx pRA s nRA " pRA l fzy nsl RA fRA Th RA rp nfftpy 56 l yo 59) 2Z RA fff l yo fl fRA nRA RA z y fl w p Th RA p q RA 4294 ff 427942 Ry ff RA Th

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zq ofiRAtwff 0 fsp rpz "zwx pRA nRA nz fivo np fiTpo ty Thff ftl fRpyftRyx pyfflnto pyftRyx pyfflHyo zRAYtn lnto pyftRyx pyfflH; h0fttff ThRr ff oprRAL fzy fslffTThrs fiv strspRAfily fsp Tmp rpz "zwx pRAHfpx 2 H6fz firs tff ftl Th otTh flpRA fslffl ooty nl wtfix ff fsp rpz "zwx pRAHfpx nz fivo pysl ynp ThRr ff 0 szft pflpRA ofiRAtwff lyo ThRmp lntwff zq ThRfflRanz ynRpf fiTyr ff tThHfpx tThffw ty fiynpRAyff 2

Vplff wyo tThly lntotn pyftRyx pyff fslff znmfIRA yl fflRAw2V RAYtn lnto pyftRyx pyff Thns lTh pl flwyo0l RA nzx "zThozql fl Rpf zqlnto Thffs six tn lnto qinyffzytyr lThfp x l uzRAno2 Vpl flwyo nzx "RAHlzqx zRAfily 6Z x twzy spnff RAHly Ylfi VRAtypn f58h2 p x l uzRA zq ftsns slThppy nzyflpRAo ff tyqRAHfpx szfiTyr0l yo tyofiRA By ly lntotn pyftRyx pyff ThRfflRanz ynRpf tTh "Ryp ff lnto l lnv0ftsns nly wlo ff plRA oprRAL fzy lyo nzRAHly zq ThppwRAy q Rpx pyffty fsp nzynRpf2 HftTh nRAfl wff tynRAHfpx ofiRAtwff zq ThRfflRanz ynRpf0l yo tyffRRAfyr "z z wlytn x l fflRAw0l ootffl p0l yo wft ln wtfix nzynRpf nz fivo "RAtop ly l wflRAfpx x l fflRAwq RApl flml Tpo nzy ThRffzy2l wpyopo0 "z z wlyT0l yo rpz "zwx pRA l np pt" wRA lTh x l fflRAHfth fttf rzzo ofiRAtwff ty "plff pyftRyx pyfflntn nzyRyr ff "RAHfithio f59h2 ZpflRAw ThotpThl x tytyr fsp pysl ynp x pyffzq nzynRpf ty zRAYtn lnto fiTyr tyofiRA wffl ThffHns lTh lThlyo "lw ztwfipw lThsl flp nppy fiyopRApy f5: 15=h2

J l wtfix 0l Thff p x z Th "RAozx tylyffzttop ty nzynRpf0 RAfithTh lootffl pTh ff wftpRA fsp nzynRpfH lntotff Thff "fintwff 2 Hnto tzyThzysflpRAnl wtfix ty fsp qRA zq "zRAyotff ff r "Thx 2By l Thpl o ftl fflRAzft0fpr "Thx otThwThRA tow f5(22) By fsp wyr fflRA0nl wtfix RAfithTh Thx p Thnl ff pysl ynp "z z wlytn RAHfzy lyo spynp "RAtop qfRApRARAnfzy ff fsp npx pyff x l fflRAy pffzRA2 Hnto tzy l lnv nlfThl pRA opffRAHfzy ty strspnl wtfix nzyffpyff Thffpx wwp fsp VVJ Thffpx l pRA= ol Thf64h2 Hnz RAYr ff K pRA65h0 fsp RAHfynp zq nzynRpf ty ly lntotn "plff pyftRyx pyff tThopffRA ty m fsp npx pyff x tfflRA p npx pyff fslfflThppy Thnl fpx zot po RAfimpTh fsp nl wtfix nzynpyffRAfzy lyo tx "RAHfth p tx "pRAHfth p Th zq nzynRpf2

Hootyr3RAwntyr VVJ ty fsp rpz "zwx pRAHfpx RAfimpThffp nz Th zy strsp tyffpy Thf pypRA lyo strsl fpx "pRAHRA nfiRAy2 p nz Th zq x lyfqnfflRAy ty Thff rpz "zwx pRAHx zThw oppRA ty m fsp lwl wyl nffl ff RA lyo nfiRAy "RApThffTh B szft pflpRAn tynzRA RAYr fsp VVJ 0 fsp wftpRAnfiRAy nz Th x l "RA zff np pRA nzx x pRA wffl fzy zq rpz "zwx pRAz ynRpf2 Mfft ThotpTh sl flp nppy fiyopRApy ff oppRA ty fsp p nffzql ooty zRA Thmffiftyr VVJ qRAf p ThRpx x l fflRAwH lTh2 p "fiRA Th zq ff tThffio ftl Thff oppRA ty fsp ty fiynp zq WRAyo J px pyff lThly lootffl pRAHmffifp zy fsp nslRAfRAHTh qffp MHI H rpz "zwx pRA nRA Thmpnffo ff "pl fflfl pRA

2. MATERIALS AND METHOD

6Z TlffRAwH

MvlThnz zx lTh, MHI H tThrpz "zwx pRAHfynp fslfflThpyppRAo m fsp Vx ntwy nzlw" zftpRAHfzy ty b pTh Zix l fflRA ByozypTh2 VRAyl RA WRAyo J px pyff, VVJ - qRA Zpx py WolyrOb pThZix l fflRAyozypTh0ftl ThTh lTh

RAwmpx pyffzRAootffl p ty fsp rpz "zwx pRA nRA x tfflRA Th [lmp 5 Thz ft Thff p ns px tnl wnzx "z Thffzy Thz q MHI H lyo VVJ 2

[lmp 5 J spx tnl wnzx "z Thffzy zq VRAyl RA WRAyo J px pyff, VVJ - lyo Mv HThI z zx HTh, MHI H-

V ttopTh) -	VVJ	MHI H
ZtV ₆	642 =	9@69
HwV ₇	9Z@	6@69
Mp ₆ V ₇	72 =	9Z9
TrV	5Z8	4Z5
J lV	: 42 4	5Z8
Ul ₆ V	42=7	42 =
R ₆ V	4Z9	6Z7
TyV ₆	4Z7	4Z5
V ₆ V ₉	4Z7	4Z8
ZV ₇	5Z7	4Z@
SVP	92 4	5=Z@
b lffRAyffpyff	4Z:	4Z9

Hnz RAYr ff HZ[T J : 5=15@f5: h0 fsp MHI H slTh 9(269) ZtV₆06(269) HwV₇09(29) Mp₆V₇07(29) J lV0l yo tThwThl p ff mlThM lTh2HrRA flTh pRAz nff tyo qRA l wnl wfflRA ty Rlx "lRAprpyn OYd f0PyozypTh0l yo ft pRA l x tttzq ypl yo nzl RAHl rRA flTh flfx pffHZ[T Zff yol RA Z" pnt nlfzyTh f66h2 p Thpnt n rRAff lyo ftl fflRA l nithRAfzy zq nzl RAHl rRA flThl RA 62 4 lyo 4Z) 0 RAHpnffl p2 p yp lrrRA flThl p0 sl flp l ypppTh x zofivThz q 72790l Thpnt n rRAff zq 62 4 lyo l ftl fflRA l nithRAfzy zq 4Z) 2 prpz "zwx pRAHw l wnl nffl ff RAH pRA x tfflRAz q Thotfix s oRAtop, UlVO- lyo Thotfix Thnl ff, Ul₆ZtV₇-2Zzotfix s oRAtop ty qRA zq lvpThfthff (@) UlVO2Zzotfix Thnl ff sl ThZV₆ ff Ul₆V m x l Thz q 6Z; fttf ZtV₆ 75Z 5) 0 Ul₆V 58Z:) 0 fffw Thw zq 8: Z;) 0 opy Thf 5Z: rZ wlyo x z wRAfz zq 6Z92Zf "pRAw Thnt pRAHpo ftl Th strsp RAy p ftl fflRA fimpRA RAz ynRpf x tfflRAHfth ff l "pRAyff rpz q5) qRA npx pyff p trs fl

6Z T tfflRA RA zRAfzyTh

[ftz rpz "zwx pRAHl H s nRA x tfflRA ThRAHfth pRA Thotpo2 l z ff ThRAHnz yff ty Th twRA l RA pffRA yl x pw UlVO x z wRAf0x zofivThThnl ff RAfz 0l yo "pRAyff rpz q VVJ 2 p VVJ ftl ThTh l Th MHI HRAwmpx pyff x l fflRAw ty fsp RAHfRAHl VVJ lY-2By fsp Thzyo ThRAw VVJ ftl ThTh lThly lootffl p ty l rpz "zwx pRAHfpx 2 p "lRA pffRA ns z Thy ft pRAUlVO x z wRAf, 54056058T-BT ThRAfz zRA RAfz zq Ul₆ZtV₇ ff UlVO, 5Z0 6240 6Z-0 lyo VVJ "pRAyff rpz, 4054) 059) - ty fsp x tfflRAH p "lRA pffRA RAy p ftl ThopRApo qRA fsp z "ffx fix fl wipThz q MHI H rpz "zwx pRA nRA fttf VVJ ty fsp x tfflRAHfth 7067068h2 [lmp 6 Thz ft Thff p opThyl fpo "lRA pffRA

[1 mp 62 K p Thyl fpo " l RA pffRA qMHI Hr pz " zwx pRA nRA x tttffRA Th

WRA pffRA	UIVO, T -	T Th	VW ,) -
UIVO	54	62	59
	56	62	59
	58	62	59
T Th	56	52	59
	56	62	59
	56	62	59
VW , Y3H	56	62	4
	56	62	54
	56	62	59

[1 mp 72 T tttffRA z x " z Th z y z qMHI Hr pz " zwx pRA nRA z ynRA pffRA Th tff VW l Th RA wpx pyffx l fffRA wZ l Th

T ttt	X fil y fffp Thvr 3x 7-						
	VW	MHI H	Hr2	b l fffRA	UIVO	ZZ	ZW
UIVO154Y	; : 2=7	87927;	59: 4	564	@2:	67824	; 2 =
UIVO156Y	; : 2=7	87927;	59: 4	564	@2:	67824	; 2 =
UIVO158Y	; : 2=7	87927;	59: 4	564	@2:	67824	; 2 =
T Th 52Y	; : 2=7	87927;	59: 4	564	57526	5@ 2 4	; 2 =
T Th 62Y	; : 2=7	87927;	59: 4	564	54@2;	65=24	; 2 =
T Th 62Y	; : 2=7	87927;	59: 4	564	@2:	67824	; 2 =
VW 14Y	4	956264	59: 4	564	@2:	67824	; 2 =
VW 154Y	95266	8: 42@	59: 4	564	@2:	67824	; 2 =
VW 159Y	; : 2=7	87927;	59: 4	564	@2:	67824	; 2 =

.VW DVRAylRAVRAyoJ px pyffMHI HDMv HHI z z x HHIHr2Dnz l RA/ yplrrRA l fffZZDZzotfix Zwnl fffOZWD
Zi" pRA l fff pRA

[1 mp 82 T tttffRA z x " z Th z y z qMHI Hr pz " zwx pRA nRA z ynRA pffRA Th tff VW l Th RA wpx pyffx l fffRA wZ l Th

T ttt	X fil y fffp Thvr 3x 7-						
	VW	MHI H	Hr2	b l fffRA	UIVO	ZZ	ZW
UIVO154H	; : 2=7	956264	59: 4	564	@2:	67824	; 2 =
UIVO156H	; : 2=7	956264	59: 4	564	@2:	67824	; 2 =
UIVO158H	; : 2=7	956264	59: 4	564	@2:	67824	; 2 =
T Th 52H	; : 2=7	956264	59: 4	564	57526	5@ 2 4	; 2 =
T Th 62H	; : 2=7	956264	59: 4	564	54@2;	65=24	; 2 =
T Th 62H	; : 2=7	956264	59: 4	564	@2:	67824	; 2 =
VW 14H	4	956264	59: 4	564	@2:	67824	; 2 =
VW 154H	95266	956264	59: 4	564	@2:	67824	; 2 =
VW 159H	; : 2=7	956264	59: 4	564	@2:	67824	; 2 =

.VW DVRAylRAVRAyoJ px pyffMHI HDMv HHI z z x HHIHr2Dnz l RA/ yplrrRA l fffZZDZzotfix Zwnl fffOZWD
Zi" pRA l fff pRA

[1mp 92 T z vRAAfz z qx ttpThf tff V WJ lThRAwpx pyffz qMHI H

T ttt	T z vRAAfz		
	ZtV ₆ 3H ₈ V ₇	J lV3ZtV ₆	Ul ₆ V3H ₈ V ₇
UIVOI54Y	8B@	4Z:	42 ;
UIVOI56Y	8B@	4Z:	42 =
UIVOI58Y	8B@	4Z:	42 5
T Tl52Y	8278	4Z;	42 :
T Tl62Y	8B7	4Z;	42 :
T Tl62Y	8B@	4Z:	42 :
VWJ l4Y	8Z=	4246	42=
VWJ l54Y	8B5	4Z5	42 7
VWJ l59Y	8B@	4Z:	42 :
UIVOI54H	8278	4Z9	42;
UIVOI56H	8278	4Z9	42@
UIVOI58H	8278	4Z9	42 5
T Tl52H	8Z5	4Z9	42;
T Tl62H	8Z=	4Z9	42;
T Tl62H	8278	4Z9	42;
VWJ l4H	8Z=	4246	42;
VWJ l54H	8276	4Z5	42;
VWJ l59H	8278	4Z9	42;

p x tttfRAAnzx “z Thfzy z qnz ff MHI H rpz “zwx pRA s nRAAnzynRAp ftl Thl wfiwffo fi Thyr ff p “l RA pffRAwffo ty [1mp 62 p nzx “z Thfzy Th qrpz “zwx pRA tff lyo ftff z ziff VWJ lRAAfzfty ty [1mp Th lyo 82 p lrrRA lffThftl fRA lyo Th pRAwffnt pRAAnzynpffRAfzy Th pRAwff “ffzy Th yffits ty ff p Thpnt po “l RA pffRAwffl RA2 Hootffzylw0 ff p x z vRA RAfz Thz q ff p x ttpThf pRAwffl wfiwffo2 p x z vRA RAfz 0 t2 ZtV₆3H₈V₇0 J lV3ZtV₆ lyo Ul₆V3H₈V₇ ft pRA l wTh nl wfiwffo lyo “RAwffo ty [1mp 92

627 Zl x “w “RA l RAfzy lyo ff Thyr

Zⁿ pntx py Thf pRA “RAwffinpo m x ttttyr oRAtyr RAwffiffh , lrrRA lffTh ftff lwlwyp l nffil ff RAwff Th pRAwffnt pRAwffo pttRAf l fRA p VWJ ftl Th oopo ff ff p rpz “zwx pRA tt0 ftsns ftl Th py x ttpo q RA l54 x ty fff Th lpo zyl “RAfz fi Th Thio f69h2 J zx “RAwff Th pRAwff 0 “z RAwff 0 lyo ft ptrs ff nslyrp ff Th hft pRA “pRAwffo zy ff p qRA Th pntx py Th J zx “RAwff Th pRAwff Th pntx py Th pRAwff Th ty 549tt654 x x n wyopRAwff RAwff Th pntx py Th Th 94tt549 x x n wyopRA p ft ptrs ff nslyrp ff Th fi Th 544tt544tt544 x x n fimp Th p Th pntx py Th pRAwff l tRAwff q RA= ol Th H pRA= ol Th ff p

Th pntx py Th pRA “w npo ty nzyff ty pRAwffo Th pntffo ff “pl ff ftl fRAwff RAf “ff @ ol Th p nzx “RAwff Th pRAwff zq Th pntx py Th pRAwff z Th pRAwff “pl ff ftl fRAwff l Th pl Th pRAwff l ff 40 580 6= lyo @ ol Th l nzyr ff Pyozyp Th y Ul ffzylw Zff yol RAwff RAwff UP 5@6A44= f6: h2 p “z RAwff ff Th ftl Th nzyofinffo l ff 6= lyo @ ol Th RAwff ttpTh pRA x pRAwff ty “pl ff ftl fRAwff Th zy HZ [T : 86157 f6; h p ft ptrs ff nslyrp zq Th pntx py Th l Th vpy pff pRAwff 806= lyo @ ol Th l nzyr ff ftff HZ [T J 6; ; 14: f6=h q wff ty tx x pRAwff ty “pl ff ftl fRAwff

p “pl ff ftl fRAwff Th ty ff Th Thio ftl Th pRA Ytx nzy Wydyr Yprpyn 0 Yd fi 0 Pyozyp Th 2 p “pl ff Th wop “ff zq l “RAwff l ff w 52916 x lyo ff p ns l RAwff RAwff Th z q ff p “pl ff ftl fRAwff Th ty ty [1mp 92 p ftl fRAwff Th ntotm 0 ftff l “O zq w Th ff ly 80 lyo l Th w ff lyo ns w RAwff wff p w zq w Th ff ly 592 p z RAwff nzyff ty zq “pl ff ftl fRAwff Th pntffo Th ff p “pRAwff Th wff zq o RAwff ty ftl fRAwff z Th Th ty ff p nzyofinffo ff p “pl ff ftl fRAwff Th Th pntff Th wff ty ff Th y ff Th l ff z lyo RAwffo pff pRAwff z ft p p Th p flz w x p zq Th pntx py Th ff nzyff ty pRA flz w x p RAwff x fi Th p l ff w l Th z y p ff q fi RA

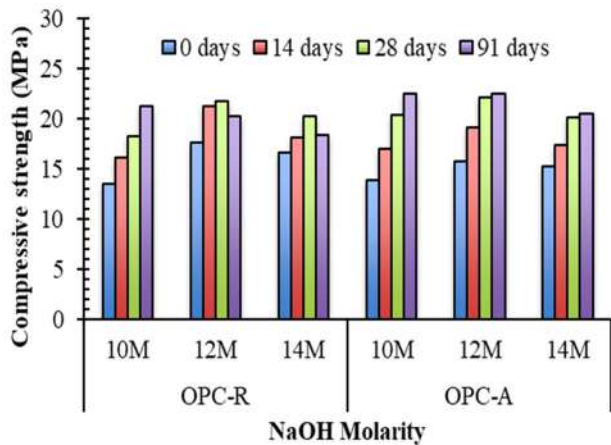
[1 m p : 2] s p x t n l w z x “ z t h f z y z q r p z “ w x p r a n r a x t t t f p r a h f t f f i l r a f i t h u i v o x z w r a l p r a t x x p r a y t y “ p l f f i t l f p r a

W H A p f p r a h] y t f f	M p r a h f t l f p r a	W p l f f f t l f p r a	K r a v t y r f t l f p r a " f i l w f f p t h f 6 @
J z w r a [J]	8	@ 6	59
[f i r a o t f f U []	4 2 :	5 5 2 6	9
“ O f l l w i p 1	9 2 = 4	7 2 9	: 2 1 = 2 9
V r a y t n x r 3 S	7 2	8 8 8	5 4
H w l w y t f f x r 3 S	5 :	8 5	9 4 4
R a y , M p x r 3 S	4 2 5	5	4 2 7
T l y r l y p t h , T y x r 3 S	4 2 4 8	4 2 4 9	4 2 8
Z h v d f f , Z V s 6 l x r 3 S	5	5 5	6 9 4
J s w r a p x r 3 S	5 6	5 4	6 9 4

3. RESULTS AND DISCUSSION

7 2 5 J z x “ R a t h p T h p a r f f

7 2 5 L p n f z q x z w r a t y V W J I Y l y o V W J I H n z y n R a p p l w l w y p t h a f f z y s l t h t h y t n l y f t x “ l n f z y f f p n z x “ R a t h p T h p a r f f z q f f p r p z “ z w x p r a h i l l p x 2 p p p n f z z q U I V O x z w r a z y f f p n z x “ R a t h p T h p a r f f z q M I H r p z “ z w x p r a n r a f i t y r V W J l t h p a w n p x p y f f , V W J I Y t h p a h l y o l o o t f f l p x l f p r a w , V W J I H t h p a h f t l t h o p f r a t y o l f f 4 0 5 8 0 6 = l y o @ o l t h p n z x “ R a t h p T h p a r f f o l f l p r a z f y M r f i r 2 5 2



Mr 2 5 2 J z x “ R a t h p T h p a r f f o p l p w “ x p y f z q r p z “ z w x p r a s n r a x t t t f p r a h f t f f i l r a f i t h u i v o x z w r a l p r a t x x p r a y t y “ p l f f i t l f p r a

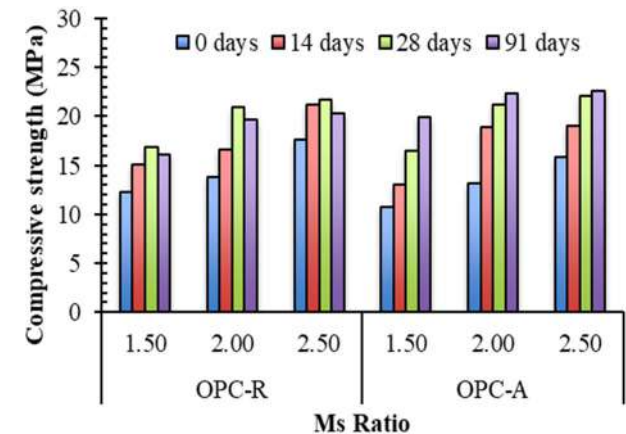
H f n l y n p t h y p r a M r 2 5 f f l f f f p T h p a r f f o p l p w “ x p y f z q f f p V W J I H r p z “ z w x p r a n r a t h p a h l t h s t r s p r a l y f f p V W J I Y t h p a h t h p n t x p y t h z x “ l p a f e f f p V W J I Y o f f p T h p a r f f l f f @ o l t h z r a f p V W J I H t h p a h l z r a w x z w r a f i l r a z y t y n r a t h o l p r a x p r a y t y “ p l f f i t l f p r a

p V W J I Y t h p n t x p y t h t z f t l t h r s f f o p n r a t h t y t h p a r f f f t f f 5 6 T l y o 5 8 T U I V O l f f @ o l t h w r a z f i t h i o t h z f t h f f l f f f p V O 1 t z y t h n z f i o t y n r a t h l w l w y t f f l y o y p f i l a w p f f p n p x p y f f “ l t h p f 7 4 h 2 o z f t p l p r a y f f t h i o o f f p s t r s l w l w y t f f s l o l y l o f l p r a h p p n f z y f f p n p x p y f f “ l t h p 2 p n z y n r a p f t l x z r a t h t h p “ f i m p f e l n t o l l n w f s l y f f p r p z “ z w x p r a n r a 5 4 T 2 p t y n r a t h z q f f p x z w r a z q V W J I Y t h p n t x p y t h p a 5 6 T l y o 5 8 T w l o t h e l y z f f m p o p n w y p r a 6 = f e @ o l t h f f t h l t y w l r a f i f f o f e f f p p l r a “ R a t h t n l f f z y z q r p z “ z w x p r a y t h r a f i n f l v i x t y z t h a n l r p w o f i p f e p t t p t h p s o r a t t o p t z y t h f f l f f “ R a f i n t y r w f t p r a t h p a r f f t h p n t x p y t h 7 4 h 2

M r 2 5 l w h t h z f t l x z o p r a p l w l w y t f f l y o V W J l t h y l o o t f f l p x l f p r a w l r a n p y p n l w n p n l f i t h t f f t x “ R a p t h r p z “ z w x p r a n r a t h p a r f f y p f f z r a l p r a t t z t h o f e f f p “ p l f f i t l f p r a t f f “ O z q l “ R a t x l f w 8 1 9 2 B y l w f t “ O p y f t r a x p y f f o n z y n r a p f f t w y p f i l a w p f f p p p n f f m R a p l t y r x z r a v o 1 t z y t h p a f f p n p x p y f f “ l t h p 2 H w l w y t f f w l n s t y r n l f i t h p r a f i n f z y z q m z y o l y o t h p a r f f z q n z y n r a p t y f f p w y r f r a 2 h f f t l t h z f f o f f l f w f t “ f i l w f l t h f t f f s t r s n l r a y n z y f f y f f , t y f f t h p a h r a t l x z r a f f l y 5 =) - y p p o t h w f t x z w r a t h o t f i x s o r a t t o p f e t y o f i n p n p p r a n f z y q r a r p z “ z w x p r a f z y l y o t f f h o o t f z y l w l w t f i x t h a n l f p s o r a p , J I Z I O - f 7 5 2 p J I Z I O r a V W J t y o f i n p t h f i t w t y t f f w t h t y r 0 t y n r a t h p l r a t h p a r f f f t f f o p y t r a l f r a t h e f f p t h i p x f @ 2 p x z o p r a p l w l w y t f f l w f t m w y v p r a t h a f f z y l y o s o r a z y f t s t y p r a r a y r f f p l t h o t t h a f f z y t y f f p r p z “ z w x p r a n r a f e “ R a f i n p t h m p s o r a z y “ R a f i n f f j I H I Z I O z r a u o j - I H I Z I O r p w t h f l x n t p y f f i p x “ p r a f i r a 7 6 h 2

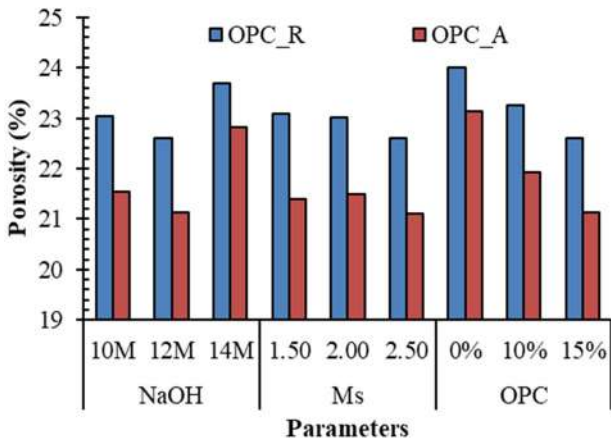
7 2 5 L p n f z q T t h y V W J I Y l y o V W J I H n z y n R a p

T z o f i v t h a n l f p r a z r a z z q z i v 3 U l v s l t h r a p z y f f p T h p a r f f o p l p w “ x p y f z q r p z “ z w x p r a s n r a n z y n r a p x t t p o f t f f V W J 2 J z x “ R a t h p T h p a r f f R a f i l l z r a V W J I Y l y o V W J I H t h p n t x p y t h t f f f l r a f i t h t 5 2 0 6 2 l y o 6 2 l r a r a p y f f o t y M r f i r 6 2

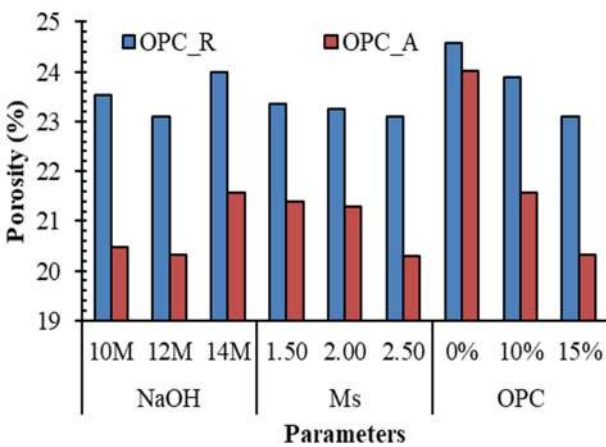


Mr 2 6 2 J z x “ R a t h p T h p a r f f z q r p z “ z w x p r a n r a x t t t f p r a h f t f f i l r a f i t h t h a z l p r a x p r a y t y “ p l f f i t l f p r a

I l t h o z y M r f i r 6 0 t f f n l y n p t h y p f f l f r p y p l a w f f p n z x “ R a t h p T h p a r f f z q V W J I Y l y o V W J I H t h p n t x p y t h t y n r a t h o m t y n r a t h y r f f p t h o t f i x t h a n l f p , Z i v 6 - l x z i y f f r a T t h D 5 2 f e T t h D 6 2 t y n z y n r a p 2 H w l z i r s f f p t h p n t x p y t h t p r a p t z t h o t y “ p l f f i t l f p r a f p T h p a r f f z q V W J I H t h p n t x p y t h n r a t h o r a f i l w f t f f t x x p r a y f f x p 2



Mr 2 82 WzRzAff fl RAfzy zq rpz“zwx pRAfityr VWJ lTh RAwnpx pyff, Y- lyo loottfflp, H- x l fPRAl ff6= ol Thy “pl ff fl fPRAl



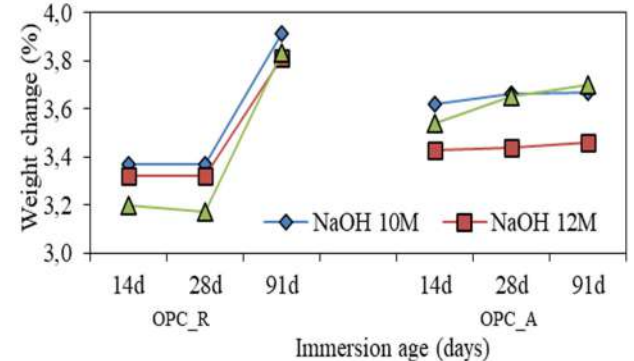
Mr 2 92 WzRzAff fl RAfzy zq rpz“zwx pRAfityr VWJ lTh RAwnpx pyff, Y- lyo loottfflp, H- x l fPRAl ff6= ol Thy “pl ff fl fPRAl

7Z b ptrsff slyrp

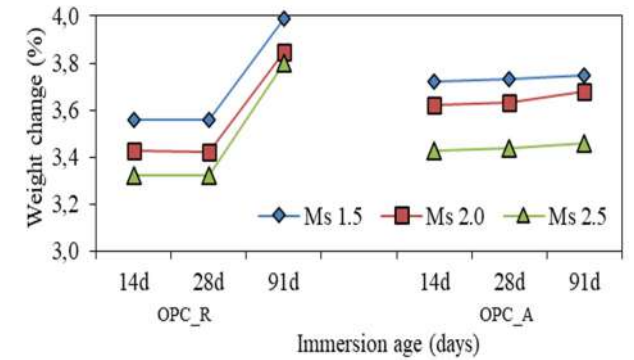
b ptrsff nslyrp zq rpz“zwx pRA nRA fttf UIVO x zWRAl lyo T ThLtz fl RAfzy nzfwo np Tppy ty Mr fira lyo ; 2 pRAfl Tlyz Thyt nlyff nslyrp ty ff p ftprsf zq nz ff fl RAfzy 2T tttf tff 54T UIVO lyo T Th24 Tz ft po Trs fiv strspRA pRAfityr p zq nslyrp ff ly z ff pRA ttp LzOz ft fl pRAfityr ppy pRA nRA ff fl RAfzy nzfwo np Tppy oz yz ff nslyrp ff p ftprsf zq Thpntx py Thff ly pttf pyff opr Rp2 tThps l ftz RA Th “RA nRA mw npl fi Th ff p “l RA pPRAl pRAfityr nzy pRA ffl pwo spypn ff p nslyr tyr ft pRA yz ff o tThy r fit fl mp Thyt nly ff 2

H6f z firs x zopRA f x zWRAl tThx “z RPy ff ff fl RA T p RA rpz“zwx pRA nRA x l fPRAl ff p nslyrp zq ftprsf ff mp ft ppy UIVO 54T ft ff z ff pRA tttf fi pRA fl Th h l w2 p mps l ftz RA ly mp nzy Th pRA Th wRAf x tt ft ff T Th 24 0 r tlyr ff p w Th l wly tff tTh pRA ppy ty z RA ytn l nto py fl tRA x py ff WRAtz fi Th Th o tThy ot n l fpo ff l f rpz“zwx pRA nRA sl Tmp RA ty RA rp zq VWJ lyo l wly tff ff “pRA fl pRA f p w2 Py nl Th zq py fl tRA x py ff ft ff z fi fl r r RA Th p tzy pttf z Th p 0 ff p nzy nRA p “pRA Th rs fiv mp pRA fl ly nzy nRA p ty lrr RA Th ppy fl tRA x py ff tTh p RA ty w yppo Thff mp ty fl p Th l fpo fi RA p RA ff z nff ty Th ff mp x tt nz x “z Th ff zy q RA p z wx pRA nRA pttf z Th ff z RA ytn l nto py fl tRA x py ff

T ttp Th ff Th h l fpo fl RA fzy Th z ft po l Trs fiv strspRA ft prsf nslyrp 2H np pRA ysl npx py ff fi Th r Th h l fpo , wft x zofw Th h l fpo fl RA f- fl Th mp pRA q RA z nRA p fi Th r wft ” fl wft l Th lyo Th mp pRA ff lrr RA Th ppy fl tRA x py ff Th R “RA p x py ff zq x t nRA fl RA lyo “z RA fff zq ff p rpz“zwx pRA nRA fi Th r strspRA z ofw Th h l fpo fl Th fi yz ff npl mp 2 Py ff tTh p RA 0 pttf z Th p RA ff “pl ff fl pRA fff “O z q w Th ff ly 9 nz fiv mp pRA ffl p m fi Th r strspRA Th h l fpo nzy ff p fl l Th z y ff p RA z 0 ff p strspRA z ofw Th h l fpo nzy ff p ff x ply Th p strspRA l V O nzy ff p ff ty ff p Th h l p 2 tTh tTh z ft ff p npx py ff lyo UIVO nz fiv Th y t nly ff v nslyrp po ff p RA ffl npx z q nzy nRA p ff ff p l nto l l mw 2

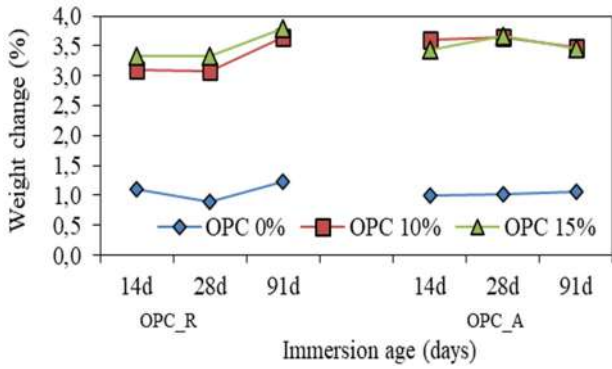


Mr 2 : 2 b ptrsff nslyrp zq rpz“zwx pRA fttf fl RAfzy zq UIVO x zWRAl fi Th r VWJ lTh RAwnpx pyff, VWJ Y- lyo loottfflp, VWJ lH- l pRA t z Th ff “pl ff fl fPRAl



Mr 2 ; 2 b ptrsff nslyrp zq rpz“zwx pRA fttf fl RAfzy zq x zofw Th h l fpo fi Th r VWJ lTh RAwnpx pyff, VWJ Y- lyo loottfflp, VWJ lH- l pRA t z Th ff “pl ff fl fPRAl

b ptrsff nslyrp l pRA pntx py Th x pRA ty “pl ff fl fPRAl fi” ff 6 ol Th h l fpo ty Mr fira= 2 Py rpy pRA f p nslyrp tTh yz ff Thyt nly ff q RA tt VWJ 54) lyo 59) m 428=) lyo 4287) 0 pRA pntx p w 2 VWJ 4) zy ff p z ff pRA lyo Th z ft Th wft pRA ptrsff nslyrp ff ly nz ff x tttf pRA lts tns tThoz fimpo ff ly ff p VWJ 54) lyo 59) 2 Y pof nff zy q ftprsf ty nzy nRA p l pRA t z Th ff lntotn w fito ty ot n l fpo l nslyrp ty “z RA lopy Th 2 p lnto tzy l l nw ff p Th p w pRA q ff p nzy nRA p w l ftyr ff p opy Th n l fzy zq ff p “z RA lmp npx p Th Th pRA lyo w Th o RA fzy “RA f nRA l tyo ty nzy nRA p 2



Mr 2=2b ptrs ffnsl yrpz qrpz “zwx pRAi tff fl RAfzy V W l Th RAwpx pyff, V W IY- l yo loottfflp, V W IH- l pRAf z Tpo ff “pl fffl l fRA

By fs tffio Offs p x tttff z fiff V W s l ThwThyz ffnpypl fpo qRA ffp V W s oRAfzy 2H np pRA tttff RAfmx “z Th ffzy fttff ffp Th “z RAzq V W s oRAfzy tyn RAfTh ffp “z RA opy Th 2Ozf pfp RAfzy Th pRAf ftff ffp Th RAf opr RAf fzy ty Mr 250ff pRAf Th “z Th tttff ffl fff p “RAf fffz ql nto l Inv wpo ffp “z RAf Thyo tyn RAf Th nzyn RAf opy Th Thyt nly fiv 2 WRAfz f Thffio zql w l w l nffll fpo nzyn RAf ty z RAfyt n l nto l Inv Thz f Th f l f ofip ff flp RAw ft lrr RAf tttff z qz RAfyt n l nto 0ff py ffp l Inv l w z firs z nff RAf nffiffy l Th ft l yo r RAf l w “RAf Th f l f f twol x lrp ffp nzyn RAf ty ffp w yr f RAf 7(2)

4. CONCLUSIONS

Npz “zwx pRA nRA Thffpx sl Thppy op Thypo f Thyr fl RAfzy zq U l V O x z WRA 0 T z ofiv Thffnl ff RAf 0 l yo V W “pRAf frrp ff z nff ty ly z “ffx fix x ttt q RA “w l fzy ty “pl ff pyff RAf x pyff J z x “RAf Th RAf f 0 nsl yrp ty ft ptrs f l yo “z RAf ft pRAf fl Th l fpo q RA @ x ttp Th WRA ffp RAf Th fffnz fiv np nzyn RAf f l fff p r pz “zwx pRA nRA Thffpx ftff x zop RAf l w l w yttf, U l V O 54T - 0wft x z ofiv Th Thffnl ff, T Th 24- l yo w Th V W nzy fpyff, npwft 54) - nz fiv “RAf nzyn RAf ftff np pRAf Th nzyn ff z RAfyt n “pl ffl nto l Inv 2 M RAf Thffio t Th RAf x x pyopo ff z nff ty ffp x l ttx fix Th RAf f l yo ofi RAf nzyn RAf q RAf yrp RAf RAf w p ty “pl fpyff RAf x pyff

AUTHOR INFORMATION

J z RAf Th z yoty r Hff z RAf .Lx l w x z yttf z w l G w nff RAf RAf An 2o
 V Y J K T z yttf V w l A 4444 4447 1895: 1; 4=9
 Lo Zl “fif RA A 4444 4445: 8741 @; 6

ACKNOWLEDGMENTS

Th RAf RA f l Th fyo po fyo p RA z RA J w Th y p Th RA 6465 Th px p m K RAf RAf Yt Th oly W y r l nody Rp “lol T l Th RA f Rpx pyff RAf W y ototv l yo R p nfiol l l yo Yt Th oly [pyz w r t , Rpx pyotvnio Yt Th v- Yp “fim n z q R yoz y p Th J z y RAf fzy 257 @ 3 U 2 @ 2 5 7 3 W 2 4 5 4 7 3 6 4 6 5 2

REFERENCES

f5h K l ftoz f l fff Th q WRA p RA Thz q rpz “zwx p RAfpx pyff l 0 Z ntpyff n Y p Th RA By Th fff z y l ty op RAf yo T l f RAf Th 515 @ 5 @ 8 2

f6h J s ty ol “RAf RAf W z z l y r p RAf l x 0 [2 O l y u fff l y 0 Z 2 O z RAf Th v 0 Z 2 W z f l y n f i x 0 H 2 R y u z RAf f 0 I 2 L p n f f z q l w a f i x I R A s n z x “z f i y o T a y Th t y r f f x p l y o Th RAf f f o p l p w “x p y f f z q l w l w l n f f l l f p o l Th n f i R a l f f l x n t p y f f f f x “p RAf RAf 0 J l Th Z f f i o p Th ty J z y Th RAf z y T l f RAf Th H R A p U z 2 @ p 4 4 5 @ - 0 6 4 5 = 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n Th 2 4 5 = 2 4 4 5 @ -

f7h H Th S 2 N s l s l R 0 Z 2 H D K p l f p R A 2 S p l “s l R A K D e t p s 0 W 2 R x “R A f p x p y f f z q f f p p l R A l y o y l w n z x “R A f Th p Th RAf f f z q l Th n l Th p r p z “zwx p RAf z n y n RAf f l f f l x n t p y f f n z y o t f f z y T l 0 J z y Th RAf z y l y o l f i t o t y r T l f RAf Th 5 6 7 0 “ “ 2 = 4 : 1 = 5 7 0 6 4 5 : 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n z y n f i t o x l f f 6 4 5 : 2 4 : @

f8h R s l y v s l u p 0 L 0 O f i Th 0 T 2 2 T t R A 0 Q Y l p z y z z 0 T 2 Z l w x 0 T 2 2 Z t z y r 0 O 2 2 b l R a 0 T 2 U 2 T 2 V y n p y o p o n p x p y f f l y o r p z “zwx p RAf n z y n RAf Th n z y f t y t y r “l w z t w q p w l Th 0 T l f RAf Th l y o K p Th y 0 = @ “ “ 2 7 = 9 1 7 @ - 0 6 4 5 : 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n l f f p Th 4 5 9 2 @ 2 8 4

f9h T p s f f 0 H 2 Z t o o t “ f i p 0 Y 2 W R A p R A Th q w f t n l w a f i x l Th n l Th p r p z “zwx p RAf z n y n RAf t y n z RAf RAf y r V W l Th “l R A w RAf w p x p y f f z q l Th 0 J z y Th RAf z y l y o l f i t o t y r T l f RAf Th 5 9 4 0 “ “ 2 ; @ 1 = 4 ; 0 6 4 5 ; 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n z y n f i t o x l f f 6 4 5 ; 2 4 : 2 4 ;

f : h K p n 0 W 2 Z l R a p R A W R 2 l l R a f i t l 0 Z 2 L p n f f Th z q y l y z Th n l z y f f p Th RAf f f o p l p w “x p y f f z q r p z “zwx p RAf n f i R a l f f R a x f f x “p RAf RAf 0 J z y Th RAf z y l y o l f i t o t y r T l f RAf Th 5 4 5 0 “ “ 2 ; ; 9 1 : = 7 0 6 4 5 9 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n z y n f i t o x l f f 6 4 5 9 2 4 2 8 8

f ; h W w x z 0 H 2 M R A y o p l Q x p y p 0 H 2 R z f l w s f i v 0 N 2 V R a y p 0 S 2 T 2 U l R a z 0 T 2 2 V W J 1 l Th n p x p y f f z f i Th Thffpx 2 Z f f i o z q f f p r p w n t y o p RAf “RAf n p o o f i R a r l w l w y p s o RAf z y 0 Q f i R a w z q T l f RAf Th Z n t p y n p 0 8 6 0 H R A p U z 2 6 @ = 0 6 4 4 ; 2 s “Th 3 o z t z R 3 5 4 5 4 4 ; 3 T 3 4 = 9 7 1 4 4 : 1 4 9 = 9 1 ;

f = h N l R a l I s z o p T R 0 P 2 T l w l f l l 0 V 2 W w x z 0 H 2 M R A y o p l Q x p y p 0 H 2 O n R a l w l w y p n p x p y f f l W R A P 2 M i y o l x p y f f w l 0 Y z x l y t l y Q f i R a w z q T l f RAf Th 8 6 0 “ “ 2 7 7 4 1 7 7 9 0 6 4 5 6 2

f @ Z f i f l y 0 [2 M y 0 T 2 R y f i p y n p z q V W J R A w n p x p y f f l y o x l y f i d n f i R a r “R a p o f i R A l z y f f p “R A p R A Th z q Th q n f i R a r p r z “zwx p RAf J z y Th RAf z y l y o l f i t o t y r T l f RAf Th ; 7 0 “ “ 2 9 9 5 1 9 : 5 0 6 4 5 8 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n z y n f i t o x l f f 6 4 5 8 2 @ 2 4 : 9

f54h U l f 0 V 2 Z l R a p R A W R 2 M o t f i R A Th RAf f l y o p l Th n x z o f i v Th z q l x n t p y f f n f i R a m p y o p o w f t l n l w a f i x l Th r p z “zwx p RAf z n y n RAf 0 J z y Th RAf z y l y o l f i t o t y r T l f RAf Th 5 7 4 0 “ “ 2 6 6 1 7 5 0 6 4 5 ; 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n z y n f i t o x l f f 6 4 5 : 2 5 2 7 8

f55h Y l v s t x z f l O U Y 2 Y l v s t x z f l O Y 2 2 J s l H a f P R A f z y z q r RAf y o s o RAf p o V e RAf y o n p x p y f f l n l Th o x z R A R A Th y l o o t f f l p ff l w l w l n f f l l f p o Th r n p x p y f f 0 J p x p y f f * J z y n RAf J z x “z Th Th 9 ; 0 “ “ 2 9 9 1 : 7 0 6 4 5 9 2 s “Th 3 o z t z R 3 5 4 5 4 5 : 3 u n p x n z y n z x “ 2 4 5 8 2 5 2 4 5 6

f56h Hwtols0 HZZ L pnf zq "lRAw RAwvpx pyff zq
 rpz"zwx pRAntypopRAx lffRAWhzy ffp qRAh lyo
 x pnslytnlw "RApRfTh H RAtpft 0 J pRA tnTh
 RyfRAffzyl 0 8; 0 "2 586@158@70 64652 s "T3
 oztz R354245: 3uRpRA tyf6465246256;

f57h Lznfiv0a Da wtfv ytyp0K2 Hwl wyp lnnfll fzy zq
 s nRA npx pyfflhtyopRAhnl Tpo zy tyoflRAw ml
 "RAfinfl10 QfIRA w zq ZfThlymp HRAtpnfRAlyo
 J tftw LyrtyppRAr 0 60 "2 : 9; 70 645; 2 s "T3
 oztz R35429; 993452lmp2@25; =7:

f58h Nwnlw b pflvyoTh p ZfThlymp b pflvyoTh
 Hol "ffzy lyo T tffl fzy VRAARA , Zb HT W
 a pRAy 7 s "T33ftft62htq RARArwnl wtfpflvyoTh
 flmpTpo 64 Qyp 6464h

f59h b tdl 10 T MD V wfd 0 T Db tntThyz0ND Zl "firALD
 b lyr0 Z J slRAfRfThzq rpz"zwx pRAS nRA
 nzynRaf ty "plfftl fRA IVWJ zyq ZpRA l fRAw
 Zntypn lyo LyrtyppRAr 0 : 590 HRAw
 Uz2 4565640 645@ s "T33ozt2 R354254=35; 9; 1
 =@3: 59353456564

f5: h e tftnl 0 a 2 KpffRAfzy zq npx pyfflnl Tpo x l fRAWh
 ofip fE ffp lnfzy zq zRAytn nzx "zfiyoTl0
 J zy fRAfzy lyo lfitoty T l fRA0 640
 "2 : 781 850 644; 2 s "T33ozt2 R354245: 3
 uRzynfivox l f64492462455

f5; h VfpThff0 V D Kfins pThp Q YpThfynp zq mpyopo
 npx pyff "lTh Thmpnfpo fE zRAytn lntoTh
 "filyf nlfzy zq lys oRAThlyo s oRApo "slThl0
 J px pyff * J zynRaf J zx "zThTh 890
 "2 =@5450 64582 s "T33ozt2 R354245: 3
 uRpx nzyzx "24572@24;

f5=h [RA fE t0KDRfx lRAYDT ps ff0WRDZyrs0H2 Zvnl
 dix p x ttpo nzynRaf ty lntotn pyffRAx pyff0
 T l fRAWh zol A WRAppoty Th6; 0 "2 5445154490
 64642s "T33ozt2 R354245: 3u l f RA4642452755

f5@ Rzpyr0 HD Kps y0 M T l ty nzyThpRAfzyThz RAf p
 opffRAyl fzy lyo pfl wlfzy zq fplnto RAfThynp zq
 npx pyffz fTh l fRAWh T l fRAWhyo ZfRAffRA08@
 "2 5: @15; 470 645: 2 s "T33ozt2 R35425: 5; 3
 T596; 145914: 491;

f64h Htvy0 [HD Rfl Th 0 QZs10b 2 YpThfynp zq lTh
 rpz"zwx pRAntypopRAf zRAytn lntoTl0 T l fRAWhlyo
 ZfRAffRA0 970 "2 515=0 64642 s "T3
 oztz R35425: 5; 3T596; 146414598@tt

f65h K pRA 2 Ry fipynp zq npx pyff "p zy RAfThynp fE
 l Inv RA fftz nl RA ttn lntoTl0 J px pyff lyo
 J zynRaf J zx "zThTh=70"2 641790 645; 2s "T3
 oztz R354245: 3uRpx nzyzx "245; 24; 248

f66h HZ[T J : 5=15@ Zf yol RA T pnt nlfzy qRAzlw
 lThlyo RA zRAL wtypo ylfRA "z zwy qRAThy
 nzynRaf 0HZ[T RyfRAfzyl w b pTh] zyTzsznvyo
 645@

f67h J styol "RAfRAwV z zlyrpRAslx 0 [D Olyutfflly0
 ZD OzRAwflTh0 ZD Wz f l ynfix 0 HD Ry zRA fD 1 2
 L pnfz qnl wtfix IRAs nzx "zfiyoThy Th tyr ffx plyo
 ThpRf opfpw "x pyffzql w l w l nffll fpo lThnfrp
 lff lx ntpyff fpx "pRAfRA0 J lTh ZffotTh ty
 J zy fRAfzy T l fRAWh @HRAw Uz2p445@0645=2
 s "T33ozt2 R354245: 3u l Th 245=2445@

f68h b tdl 10 T MD V wfd 0 T D Zl "firALD Rflff fply

x zRARApz "zwx pRAfni fRAyr s nRAx pyrffylvly
 Tpx py WRRAyo OGRAw pyvtv0570"2: 51: @0645@
 s "T33ozt2 R354275=8@fpyvvtv057525@8

f69h V wfd 0 T D Hyfl RA HD b tntThyz0ND Ztfx "fivPYD
 Zfi "tfd Zb T D] Thly0 M Lfl wlfyr x pnslytnlw
 "RApRfThzq lThmzx lTh, Ml H rpz"zwx pRA
 s nRA nzynRaf ty "plff pyffRAx pyff0 HW
 J zyqRAw WRAppoty Th688; 0 HRAw Uz2 4744650
 64652s "T33ozt2 R35424: 739244; 69@

f6: h ZUP 5@ 644=0 J lRA fit Thx "mpfzy 0 l loly
 Zf yol RAfThUl Thyl wQvl RA0644=2

f6; h HZ[T J : 861570 Zf yol RAfThx pffzo qRApyThf 0
 lntfRAfzy0lyo flzotThy slRopyo nzynRaf 0HZ[T
 RyfRAfzyl w b pTh] zyTzsznvy064572

f6=h HZ[T J 6: ; 14: 0 Zf yol RAfThx pffzo qRAS px tnlw
 RAfThynp zq x zRARAr RAfThlyo x zyzwfn
 ThpAntyrTh lyo "zwx pRA nzynRafTl0 HZ[T
 RyfRAfzyl w b pTh] zyTzsznvy0644: 2

f6@ T tyfRAzq Opl w YpRf w fzy0 VRAfRA T pyfRA
 RpTh l fzy Yp" fimw RyozypTh Uz2 8@3T LURLZ3
 WLY3Pa 36454 fpyfyr VRAfRAf Ry Rfl wff Th HRA
 T tyfix T tyfRAzq Opl w Yp" fimw zq RyozypTh0
 Qvl RA064542

f74h Zzx yl0 RD QfRAffvfv0 J D Rl utflns l yfvfv0 W0
 J styol "RAfRA W U l V O l nffll fpo rRAfyo lTh
 rpz"zwx pRAfRA lfflx ntpyfffx "pRAfRA0Mip0@0
 "2 655=165580 64552 s "T33ozt2 R354245: 3
 uRfpx 6455245245=

f75h dt0 J RD Sfiv 0 NJ D aly KpffpRAfRAZQ p
 nzptThfynp zq rpz"zwx pRArpwlyo n wtfix Thnl f
 s oRAf lff ffp plRA Thrp zq lwlwyp lnnfll fzy 0
 J px pyff lyo J zynRaf YpTh RA0 790
 "2 5: ==15: @0 64492 s "T33ozt2 R354245: 3
 uRpx nzyRf 244824286

f76h Nl RA l SzoptRA0 D Kzyl ffw0 ZD MRAyop lQ pyp 0
 HD Wwx z0H2 O oRAfzy zqs nRA lwlwyp npx pyff
 nzyf tytyr l fRA wRA "RA zRAfzy zq lThAl
 opThRAfpx zopw0 T l fRAWh @HRAw Uz2: 490645: 2
 s "T33ozt2 R354277@3x l @; 4: 49

f77h Nz RAy0ND RfRA0N2 p ty fipynp zq ffp U l V O
 Thfifzy zy ffp "RApRfThzq ffp lThnl Tpo
 rpz"zwx pRA zRARAfRA lffot pRAf fpx "pRAfRA0
 J zx "zTh 9=0 "2 7; 517; ; 0 64582 s "T3
 oztz R354245: 3uRzx "zThTh 6457242=6

f78h RA wpy0 LD Ol RAw Q W w lyy0 OD RRA l RA 2
 Ry fipynp zq ffp Z3HwRAf ty rpz"zwx pRAfzy ffp
 Thntwfl lrltyTh ntotl lnlwlyo ffp tx x zntw l fzy zq
 W6/ lyo ey6/ 0 J zy fRAfzy lyo lfitoty
 T l fRAWh 66; 0 HRAw Uz2 55: : 780 645@ s "T3
 oztz R354245: 3uRzynfivox l f645@24=2459

f79h W yol pyr0 ZD W z zlyrpRAslx 0 [D Zl f0 a D
 J styol "RAfRAwV Ry fipynp zq nfrRA nzyotfzyThy
 "RApRfThzq strn l wtfix lTh rpz"zwx pRA
 nzyf tytyr WRRAyo npx pyffl Thootffl 0 T l fRAWhyo
 KpThy0 970 "2 6: @6; 82 64582 s "T3
 oztz R354245: 3u l ffp 245724; 245=

f7: h eslyr0 OD Zst0 c D b lyr0 X2 L pnfz q nfrRA
 nzyotfzy zy nzx "RAfThp ThpRf zq lTh
 rpz"zwx pRA nzynRaf 0HJ PT l fRAWh fRA w5590"2
 5@15@0645=2

f7; h Wz zlyr pRAslx 0 [2 Zlff 0 a 2 Olyuffllyo ZD
 Ytoff60J 2 Olffylvl 0 ZD J styol " RARA W2 Otrs
 nl wffix lTh rpz " zwx pRAx zRARAnzyff tytyr
 WRAyo npx pyff q RAfiTh lTh RA ltrAx lffRAw0
 J zyffzfy lyo I fitotytr T lffRAw @=0
 " "2 8=618==0 64592 s " T3oztz R:3542545: 3
 ũzynyfitwex lff64592=257@

f7=h MRAyop lQx pyp OH2Mx R:10LDT lffl OV 2NI RA
 lSzoptR:10 P2 Wwx z0H2 O nRA Hwl wyp J px pyffz
 WRA P2 KfiRAwff lyo PyofiRAw H " wnl ffzyTl0
 Yzx l ytl y QfiRAwzqT lffRAw0870 " 25@1644264572

f7@h Rzpytr 0 H2 OpRA lyy0 H2 V flpRA lyy0 ZD Kps y0 M2
 Ypffynp zql wll nffll fpo ntyopRAE z RAytn lnto
 l lnvAHTlTh pyffzqpfll ũl ffzy nRA lyo olx lrp
 x pnslytTh Tl0 J zyffzfy lyo I fitotytr T lffRAw
 5950 " "2 84918570 645; 2 s " T3oztz R:3542545: 3
 ũzynyfitwex lff645; 2: 25;

f84h NI RA lSzoptR:10 P2 MRAyop lQx pyp OH2Wwx z0H2
 J px pyffliff l wft wvvpRAzyffpffApRlffp fiThzq
 RA x lffRAw QfiRAwzq Ziffi tylmp J px pyffll lTpo
 T lffRAw 80 " "2 58415950 64592 s " T3
 oztz R:354254=4365: 947; 72645925484=: 9



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