

Brine sludge waste from a Chlor-alkali industry: characterization and its application for non-structural and structural construction materials



S' yan-n qr L 4Rāq' l' 70 2Mr ~vr J 4O ~tnl' 7 2U' pvn-n L 4c vān-v' n-q2[' t l' v' qn L' tūn] vān⁸

7R-µtē ± qr Yrµ° vānN-rlt āpnur W° pyrnlrµ2RYNW3L WNWS] Y26; ; 6A3662Klnāy

*b ~v-nl Lnlō' p' l'] 4 46; ; : 936772Klnāy

J K]a La CKlv-r µ' qtr . K] / vī n- v-q' µtāny Éñtēr tr-rlnēq v- xnltr n' z ' ° ~tū oā āur Lu' y l' 3n' xnyv- q' µtā n- q2' µ' n' yā qvµ- µr q v- ± v- q' µtāny n- q' x' µ4 Krpn' µr K] p' ~ān- µr Ār l' nypur z vny p' z - ' ° ~qµ2 n' xµ' - l' rµr ~tū n - ' ā ~āny r- Āl' ~z r- āny w - n' p' t r s' n' µo' wā' s' āur ° āyānā' ~ ' s olv-r µ' qtr Éñtēr µ' s l' āur - l' r- nlnā' ~ ' s Āny' r 3n' qqr q z nārl' n' xµ' Éñtēr- Ār µtā nē q4 r punl' n' p' t l' vānā' ~ ' s ā' olv-r µ' qtr µnz - xµ' Éñtēr - r l' s l' z r q v- ā l' z µ' s purz vny n- q - uā' µpn' y p' z - ' µtā' ~2- nlnā' p' r µār qvµt' w° ā' ~2e 3nā qv l' n' p' t ~ . e [M/2O ° l' vrl ā l' n- µ' s l' z R- s l' n' r q] - r p' t' µ' - ā . Ca Ē / 2n- q āur l' z n' y n- n' yā' µµ . Ma J Sa P / 4 N' r z r- ā' µy x' r L n2] v' Wn2V t2J v' L v' 2n- q Q' Érlr v' q r- ā' v r q v- āur µnz - xµ' t r e [M l' r µ' v' tū p' ~ l' z r q āur p' l' ā' µtāny- r- nē' l' r ' s p' z - ' ° ~qµ n- q v- qv' nē q āunā āur z n' v- p' z - ' ° ~qµ v- olv-r µ' qtr µnz - xµ' Érlr p' n' x' p' z p' n' l' o' ~nē 2 µ' q' v' z p' u' y l' v' q r 2 z nē - r µ' z uā' q l' Ś' q r 2 n- q ° nlnā' 4 Ca Ē µ' Érlr āur - l' r µr - p' r ' s Ānlā' v- t s° - p' t' ~ny t l' ° - µ y x' r p' n' l' o' ~nē 2 µ' y' Śn- r 2 n- q uā' q l' Ś' q r 4 r ā' olv-r µ' qtr µnz - xµ' p' n- or p' ~µ' q r l' r q n' n ~r - ' É' q r l' É' v' tū āur z r n- qv' z r ā l' . q. 6 / ' s : 4A : z n- q 8 : 4 @ z 2 s' l' āur K] s l' z] n- ± J ~q l' n- q L° onā' 2 l' r µ- r p' t' Ā' yā 4 r l' r µ' v' tū v- qv' nē q āunā āur olv-r µ' qtr µnz - xµ' - l' r µr - ā' q s' nā l' n' o' y punl' n' p' t l' v' tū p' t' ° µr yz r µtē - r y' r l' n- q ov- q r l' n' yārl- nā' ā' ± Y l' ān- q p' r z r- ā' v- āur ~ ' µtā' p' t' l' n' y p' ~µtā' p' t' ~ z nārl' n' xµ' t r v- p' l' - l' nā' ~ ' s olv-r µ' qtr v- t r' - ' yāz r l' v' z nārl' n' xµ' vī n- ā' āur l' - ' µ' µo' y' µr v- µ' µtān- n' o' y p' ~µtā' p' t' ~ z nārl' n' y - l' q' p' t' ā r - l' q' p' t' ~ ' s Āny' r 3n' qqr q - l' q' p' t' s l' z olv-r µ' qtr É' v' y' or n- w - l' l' ān- ā' p' ~ā' w° ā' ~ ± Énl' q' µ' µtān- n' o' y q r Ā' y - z r- ān' q' - ā' q oā āur Lu' y l' 3n' xnyv- q' µtā 4

Trā É' l' qµ' Lu' y l' 3n' xnyv- q' µtā l' R- q' µtāny' y q Éñtēr l' Klv-r] y' qtr l' n' p' 3l' v- qyā p' ~p' l' r ā' D' p' r' - ' yāz r l' p' z - ' µtā 4

1. INTRODUCTION

r Lu' y l' 3n' xnyv- q' µtā vī r µr ~āny ± āur purz vny v- q' µtā orpn' µr v' tū vī r µr ~µo' y' s' l' āur - l' q' p' t' ~ ' s p' u' y l' v- r 2 É' v' tū unū z n- ā n- - y' p' nā' ~µ' l' p' u' nū purz vny µ2 - unlnz n' p' r āpn' xµ2 ° yā n3- ° l' r z r āny µ2 - ' yāz r l' µ2 n- q ' āur l' µ h7Bj2 or µq r µ āur p' n' µp' r µ' qn - l' q' p' t' ~2 É' v' tū p' n- or n- - y' r q v- āur z n- ° s' n' p' t' l' r ' s n' yz ' µtāny p' ur z vny - l' q' p' t' ā

[r t n l' q' x' µµ ' s āur ā- r ' s ā' p' u- ' y' t ā n' q' - ā' q s' l' p' u' y l' v- r n- q p' n' µp' r µ' qn - l' q' p' t' ~ . z r z olv-r p' r xµ2 n' u' or µtē µ qv' n- ulnā z 2' l' z r l' p' lā p' r xµ2 µnyā vī µ' r q nū l' nē z nārl' n' y n- q - r r q µ' ā r nā z r- ā' z o' r s' l' r r y' p' t' ' yā' µµ 4

M' l' v- t āur µnyā ā r nā z r- ā' āur Lu' y l' 3n' xnyv- q' µtā tr- rlnē q v- xnltr n' z ' ° ~tū' s olv-r µ' qtr . K] / 4 nē v- q' µtāny Éñtēr vī tr- rlnē q v- xnltr n' z ' ° ~tū v- Klnāy n- q' µ' n' yā qvµ- µr q v- ± v- q' µtāny n- q' x' µ4

J' yā' ° tū olv-r µ' qtr tr- rlnē q s l' z āur qv r l' r- ā' Lu' y l' 3n' xnyv- q' µtā r µ s l' z qv r l' r- ā' p' ° - ā' v' tū - l' r µr - ā' tū - ' ā ~āny l' r pāp' y- t n- q l' r µr h93- j 2 āur l' r nlr ~ ' z n- ā µtē qv µ āunā q' r l' µ āur punl' n' p' t l' vānā' ~ ' s ā' v' tū ā- r ' s Éñtēr tr- rlnē q v- Klnāy 4

r l' r s' l' r 2 āur - l' r µr - ā' É' l' x n' z µ ± punl' n' p' t l' vā r 2 r Āny' nē 2 n- q p' l' r y' nā āur - uā' µpn' y n- q purz vny punl' n' p' t l' v' tū p' t' s ā' olv-r µ' qtr µnz - xµ' s l' z āur b ~v- nlnā' Lnlō' p' y l'] 4 J 4 purz vny v- q' µtā . Klnāy / ± - l' - l' µr - ' µ' µo' y' ā' r µ' s n- - y' p' nā' ~4

2. EXPERIMENTAL SECTION

84 V nārl' n' xµ

r olv-r µ' qtr Éñtēr µ Érlr p' y' p' t' q nē b ~v- nlnā' Lnlō' p' y l'] 4 4 ° - v' tū y' p' nē q v- L° onā' .] ' Yn' y 5 Klnāy / n- q] n- ± J ~q l' .] ' Yn' y 5 Klnāy / 4 r µnz - xµ' Érlr l' µtē q l' v' q nē 76; ; L s l' 8 : u' ° l' µ 4 J r l' p' ' y- t ± l' ' z āz - r l' nē l' r 2 āur olv-r µ' qtr µnz - xµ' Érlr t l' ° - q r q 4

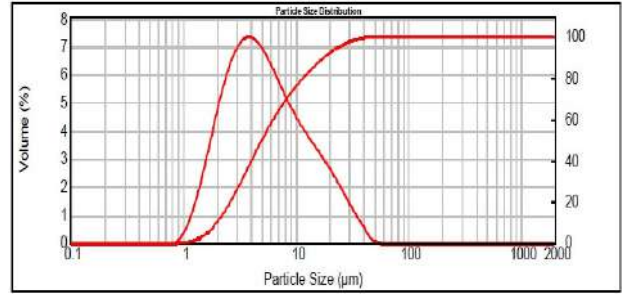
88 L unlnā' p' t l' vānā' ~ ' s olv-r µ' qtr µnz - xµ

r olv-r µ' qtr µnz - xµ' p' y' p' t' q nē L° onā' L vā . K] L K / n- q] n- ± J ~q l' L vā . K]] / Érlr punl' n' p' t l' vā r q oā qv r l' r - ā' ā' p' u- v° r µ' t r purz vny p' z - ' µtā' ~µ- v- āur s l' z ' s' Ś' q r µ' Érlr n- n' yā' ā r q oā r- r l' t ā qvµ- r l' µ' ā r e [Cē 3nā ° ' l' r µr - p' r µ- r p' t' z r ā' ā ° µ- t V n' yārl- J ~nyā' āpn' 2 g r ā z z ' q r yā e 3nā qv l' n' p' t' ~ . e [M / n- n' yā' ā r µ' Érlr - r l' s l' z r q' ~ n- e ā' r l' ā' 2 Yuyv- µ qv l' n' p' t' z r ā l' 2 ' - r l' nā' - t É' v' tū L° 3 T l' n' q nā' ~ . F 72 : 8 / 2 µpn- ~v- t s l' z ; ± ; 6 nē nlnā' ' s 7 Sz v- É' v' tū n' Ā' yā n' r ' s : 6 xc n- q p' l' r - ā' t' s ; 6 z J 4 Ynl' ā' p' r µār qvµt' w° ā' ~ ' s µnz - xµ' Éñtēr q r ā l' z v- r q oā MY]] ° µ- t V n' yārl- R- µtā' z r- ā' t 2 V n' yārl' µār l' 86662 c r l' 4 ; 4 : 2 É' v' tū āur µnz - xµ' qvµ- r l' µr q v- vī - l' - āy' n' p' u' y n- q n- n' yā' ā r q oā Q r 3 W r yū r l' 4 O - p' t' ~ny t l' ° - µ É' v' tū- āur z nārl' n' y µtā' p' t' l' r Érlr v' q r- ā' v r q oā Ca Ē . Yrl' x- N' yz r l'

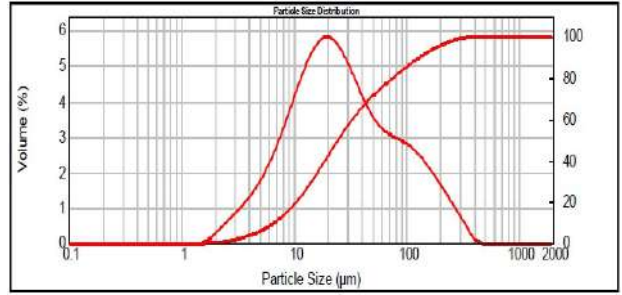
Received : S - r 7; 28687
Revised : S yā 7=28687
Accepted : J ° t ° µtā 8A28687

a noyr 9 Lurz vny p' z -' μνδ ~ .É± / ' s olv-r μº qtr μnz -yr μ4

Nyrz r~±	K]]J	K] LK
Ln	9B4	864
V t	=4 6	@ =
Wn	84B7	=46
]v	849	764
Ly	; 49	B4 =
Qr	: 46	; 48
J y	64;	94-9
Y	649	64@
]	64 6	646
T	6487	74B
a v	646	647
Ll	3	64B
V ~	64;	646
Wv	3	648
L °	3	648
g ~	64;	64A
J μ	3	648
Kl	648	3
[o	3	647
]l	84B	64=
gl	3	64B
Kn	3	649
Yo	3	648
UX R0	: 64	9=4



Ot 494 Ynl ðpx μār qvðvo° ð' ~' s K]]J 4



Ot 4: 4 Ynl ðpx μār qvðvo° ð' ~' s K] LK4

a noyr ; Ynl ðpx μār qvðvo° ð' ~μ' s olv-r μº qtr μnz -yr μ4

]nz -yr μ	Ynl ðpx qvz r ± l . z /				
	M _{0.8}	M _{1.4}	M ₆	M ₆	M ₆₆
K]]J	: 4; =	@@:	74A:	: 4A:	7@@@:
K] LK	7; 4 ==	: B4B8	=4@:	8: 4 @	78B4@

.0/ U μμ' ~ R ~ νδ ~

a noyr : Lurz vny n-q -uáμvny -l' -rl ðpx μ' s ður μº qtr μnz -yr μ4

Yl' -rl ðpx μ	K]]J	K] LK
L' ý l	yt u±P l r á	l r q q v μ
K° x q r -μνδ . t Sz U/	64@A	64: A
-Q	A@@	@B@

94 Ynl ðpx μār qvðvo° ð' ~

r qv rlr ~ ðny n-q p° z ° yntÁr -nl ðpx μār qvðvo° ð' ~μ nlr μl' É ~ v- Ot 49 n-q Ot 4: s' l K]]J n-q K] LK2 l r μ-r p ± Á r á 4 a noyr = μ' z z nlr μ ður É n Á 3 ~ z or l μ n ± É u v u ður no μ l - ð' ~ z n S v n n - r r n l v - ður μ-r p ± n' s ður z n l r v μ n - q ður d Á o l n ð' ~ n y n μ μ ~ z r ~ ð 4

L n y p' z p n l o' ~ n ± v μ n z n w l p' z -' ~ r ~ ±' s olv-r μº qtr μnz -yr μ n-q ður Oa R l μ-r p ± ° z v μ Á r l á ° μ r s' y s' l qv ðv - t ° v μ v - t n z ' ~ t qv r l r ~ ± - u n μ μ' s ðu μ p' z -' ~ q 4 r p l á μ t n y - u n μ μ' s p n y p' z p n l o' ~ n ± p n - o r q v p l v v - n ± q o á q r ± p v - t ður no μ l l - ð' ~ o n - q μ 4

94 Oa R l μº qv μ

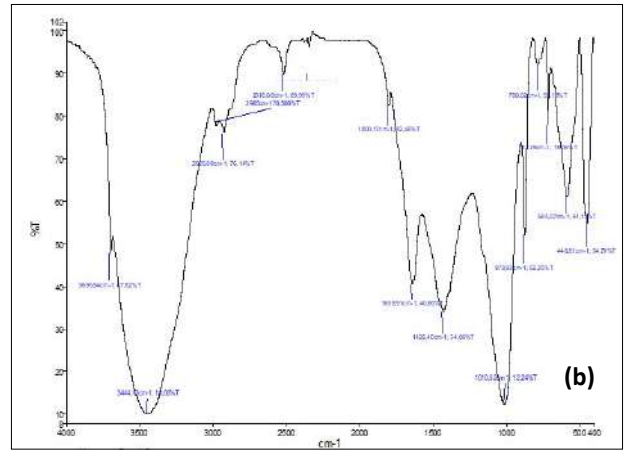
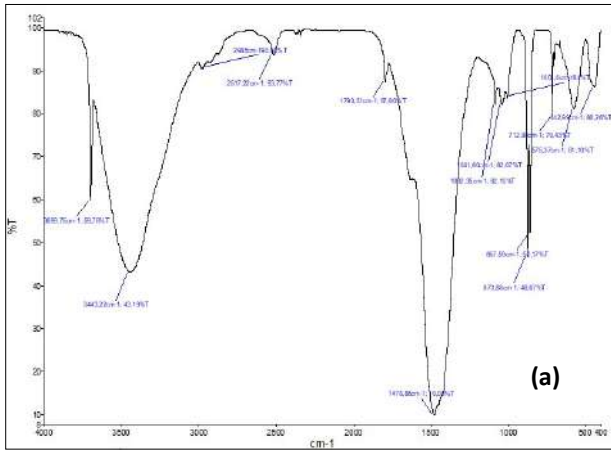
r l r y Á n ~ ± Á o l n ð' ~ o n - q μ' s ður olv-r μº qtr μnz -yr μ v Oa R l μ-r p ± n É r l r q r ± l z v - r q v - ður l n - t r ' s : 66 f i : 666 p z ° n - q n l r μ l' É ~ v - O t 4 ; . n / n - q . o / s' l K]]J n - q K] L K 2 l r μ - r p ± Á r á 4 a n o y r = μ' z z n l r μ ður É n Á 3 ~ z o r l μ n ± É u v u ður no μ l l - ð' ~ z n S v n n - r r n l v - ður μ-r p ± n' s ður z n l r v μ n - q ður d Á o l n ð' ~ n y n μ μ ~ z r ~ ð 4

L n y p' z p n l o' ~ n ± v μ n z n w l p' z -' ~ r ~ ±' s olv-r μº qtr μnz -yr μ n-q ður Oa R l μ-r p ± ° z v μ Á r l á ° μ r s' y s' l qv ðv - t ° v μ v - t n z ' ~ t qv r l r ~ ± - u n μ μ' s ðu μ p' z -' ~ q 4

r p l á μ t n y - u n μ μ' s p n y p' z p n l o' ~ n ± p n - o r q v p l v v - n ± q o á q r ± p v - t ður no μ l l - ð' ~ o n - q μ 4

r Á o l n ð' ~ s t r ° r ~ p r μ' o μ l Á r q É r l r p u n l n p ± l v ð p ' s ðé' p l á μ t n y - r p n y p' z p n l o' ~ n ± - u n μ μ . p n y p ± r n - q n l n t' ~ v r / 4 á - v p n y á 2 ður no μ l l - ð' ~ o n - q μ É r l r q v Á q r q v - ± s' l - n l ð C a u r μ á z z r ð v p μ ð r ð u' s ður p n l o' ~ n ± v ~ n ± n o' ± 76 A 6 p z ° . 7 / D ður ' ° ± 3 s 3 - y n - r o r - q v - t no μ l l - ð' ~ n ± n o' ° ± A @ p z ° . 8 / D ður μ á z z r ð v p μ ð r ð u n ± n o' ° ± 7 : 66 p z ° . 9 / n - q ður v - 3 - y n - r o r - q v - t n ± n o' ° ± @ 6 p z ° . : / h @ 4 N p u - u n μ μ' s p n y p' z p n l o' ~ n ± u n μ μ' z r p u n l n p ± l v ð p no μ l l - ð' ~ o n - q μ 4 r o n - q μ n ± R A : A 6 p z ° 2 76 A 9 p z ° 2 A ; A p z ° n l r p u n l n p ± l v ð p μ' s n l n t' ~ v r h @ 2 A j 4

r - l r μ - p r ' s Q s X v μ q r ± p ± q o á ðé' p u n l n p ± l v ð p no μ l l - ð' ~ o n - q μ v - ður 9 = @ 3 : : 6 p z ° l r t v ~ p' l r μ -' ~ q v - t ± ður μ ð r ð u v - t n - q q r s' l z n ð' ~ z ' q r μ' s X Q 3 n - q v - ður 7 = : 6 p z ° l r t v ~ n μ l' p n ± q É v u o r - q v - t Á o l n ð' ~ z ' q r ' s Q s X h B j 4



Ōt 4; 4Ōa Ē μ-rp±° z ' s. n/ K]] J n-q. o/ K]LK4

a noyr = Ē on-qμ' s olv-r μᵑ qtr μnz -γrny' ~t Ēvñ ùurđ nμm ~z r-±μ

d nĀr~° z orĭ . pz ʒ/		J μm ~z r-±μ
K]LK	K]]J	
9=B; 4B:	9=BB4@	μĕr±pυv-t n-q qrs' lz n± ~' snqμ' ĩorq Ēñrĭ z ' γp° γ nμáz z r±p μĕr±pυv-t Āoĭn± ~μ' sXQ³tĭ' ° -μsĭ' z V t. XQ/₈
9: : 478	9: : 948	μĕr±pυv-t n-q qrs' lz n± ~' snqμ' ĩorq Ēñrĭ z ' γp° γ
8B8; 4A	3	μñĕ ĩnrq L3Q Āoĭn± ~sĭ' z μ' z r w -° ĩvđ v- ùur TKĭ Lĭáμny
8; 7=6=	8; 7@88	n± μ-urĭp LX₈
89: : 4;	3	n± μ-urĭp LX₈
7A664@	7@B947	μáz z r±p Āoĭn± ~. 71 : / LX₉
7=9A87	3]v-X-]vñáz z r±p μĕr±pυv-t n-q or~qv-t Āoĭn± ~μ' s Ēñrĭ z ' γp° γμ
7: 8=4	7: @AA=	μáz z r±p Āoĭn± ~ 9. LX₉/
3	76A84;	μáz z r±p Āoĭn± ~ 7. LX₉/
767648	76: 74	μáz z r±p μĕr±pυv-t ' s]v-X-]v
A@49	A@4A	nμáz z r±p Āoĭn± ~ 8. LX₉/
3	A; @B	' ° ʒ s3-γn-r or~qv-t Āoĭn± ~ : . LX₉/
@648	3	μáz z r±p μĕr±pυv-t ' s]v-X-]v
@84@	@84B	μáz z r±p Āoĭn± ~ : . LX₉/
; A; ʒ@	; @4@]vX ʒ yo' ~q
:: A47	:: 84B	μáz z r±p μĕr±pυv-t ' s]v-X-]vñ-q μáz z r±p or~qv-t ' s]vX

J ol' nq noμ' ĩ-± ~ on-q n±R9=(@ pz ʒ v-qvnr ĩxĭ ùur -ĭrμ-~pr ' s ùur punĭnrĭvĕp sr° r-pá' s ùur uáqĭ' Šáy tĭ' ° - . XQʒ/ μĕr±pυv-t Āoĭn± ~' s z nt-rμᵑ z uáqĭ' Šqr h76277j4

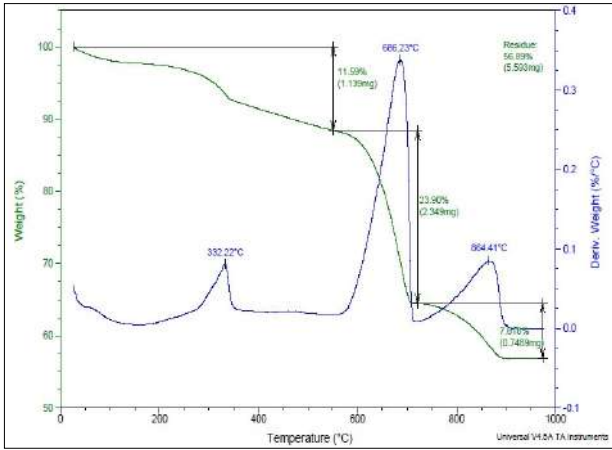
r z v' ĩ -rnx n± 8B66 pz ʒ vμ nμĭ pñr q Ēvñ n μñĕ ĩnrq L3Q Āoĭn± ~sĭ' z μ' z r w -° ĩvđ v- ùur TKĭ pláμny n-q ù' μr z v' ĩ -rnxμ ' oμrĭĀr n± R8; 66f8966 pz ʒ Ērĭr q' r ± ùur nqμ' ĩ-± ~' s ùur n± μ-urĭp LX₈ h7837: j4

r -ĭrμ-~pr ' s ° n± Ēñ Ēvñ vq~±r q oá ùur punĭnrĭvĕp noμ' ĩ-± ~ on-q n±: : A2@627676376: 62n-q 7=: 6 pz ʒ4] z ' ~t ùur on-qμ ùur noμ' ĩ-± ~ n±R66 pz ʒ2 Ēvñ vμ q' r ±]vX 3]vñáz z r±pny μĕr±pυv-t Āoĭn± ~ v ùur z ' μĕr vñoy on-q s' ĭ μvyr q r ± ĩ v-ñ ~ h7; 27=j4 r noμ' ĩ-± ~ on-q n±; A; 3 @ pz ʒ v-qvnr ùur s' lz n± ~' s ùur]vX ʒ yo' ~q h7@4

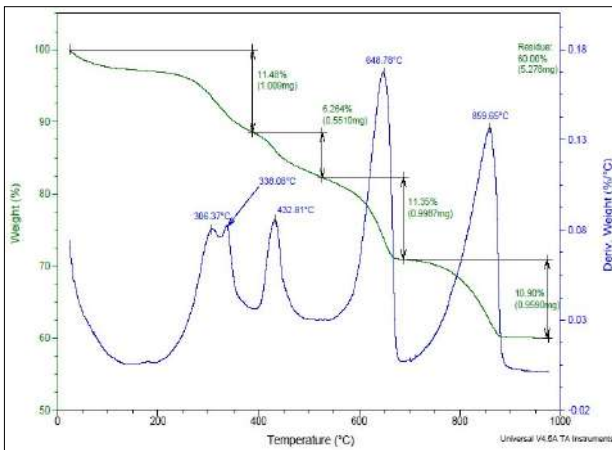
94 rĭz nyn-nyáμμ

r ùurĭz ' tĭnÁv r±p n-nyáμμ vμ -' ĩñ-±± purpx ùur ùurĭz nyĕnoyđá ' s ùur z nrĭmyn-q v±μ' μr° ys' ĩ ùur μĕnrĭv q r μt ~' s μᵑ qtr z n-ñr z r-± Ēñ ~ ùurĭz ny ùr n± r-±v v-Ā Ār q4Ōt 4=n-q @μ' Ē a PJ n-q q rĭvñr a PJ . Ma P/ p' ĩĀr μ' s K]]J n-q K]LK μnz -γrμ ĩrμ-rp±Ār yá4 r -rnx ' s ùur Ma P p' ĩĀr ĩr-ĭrμ-~± ùur ùr -rĭñĕ ĩr p' ĩrμ- ~qv-t ± ùur vtr μr ± nμ y μ ĩnr s' ĩ ùur μnz -γrμ J ~nyáav-t ùur ùurĭz ' tĭnÁv r±p p' ĩĀr μ v±μ -' μnoyr ± ' oμrĭĀr n ùurĭz nyorunÁ ĩ μz vñ orĕĕr ~ ùur ±ĕ' μnz -γrμ r ĩμt -rnxμ ' oμrĭĀr n± R96=39A L p' ĩrμ- ~qμ ± ùur qrp' z -' μñ ~' s z nt-rμᵑ z p' z -' ° -qμ h7Aj 4Ō ĩ μnz -γr K]LK. Ōt 4A/2 ùur Ma P p' ĩĀr v-±vμ ùr -rĭñĕ ĩr ĩn-tr μĭ' Ē μĕĕ' -rnx μĒ Ēvñ nĭr ĩnr q ± ±ĕ' ĩnr pñ ~μ ùur nĭr -ññnyá ' Ār ĩn-v-t 4 J ĩ' ° ~q =; 63A=6 L vμ ' oμrĭĀr ùur μt ~ny q' r ± ùur LX₈ y μ p' ĩrμ- ~qv-t ± ùur qrpñlo' ~vññ ~' s ùur pnyvĕr h7Bj4

K]J] μnz -yr -lrμr-ārq uvtur l p' -ā-ā-ā s LnLX, v-ntlrrz r-ā-ā-ā āur qnān lr- l ārq oā āur purz vnyān-nyāμq4 r-rnx -rnl : 96 L s l āur K]LKμnz -yr z nā or n lvo' āq ā āur ° nā qruāq' Šāyānt' ~ q' r ā āur p' -qr-ānt' ~ s μāyān- y t l' ° -μ lrμ' yā-t v āur y μμ' s Éntārl h8j4 Qxt u lrμq' nyz nāμ Énū s' ° -q s l o' āu μnz -yr μ nā-āur r-q' s āur n-nyāμq. R46+ / -l' onoyā q' r ā uvt u v- l t n-yp p' -ā-ā-ā z n-nyā μnyā4



Ot 4a P n-q Ma P p' l Ār μ' s K] J] 4



Ot 4b P n-q Ma P p' l Ār μ' s K] LK4

94- Nāny' nā' ~' s olv-r μy' qtr Énūā n-ypnā' ~μ

V n-ā nqĀn-ānt r μ r pāpāy-t āur Énūā r μ pn- olv-t 2μ pu nū nā' vq-v-t -' y' ā' ~ pn' μ r q oā v-p' lr pāqā- μny2lr q' p-v-t āur ~ z or l' s lnÉ z nārlvny μ r q ā -l' q' pr -l' q' pā2n-q lr q' p-v-t p' μā4 r lrs' lr 2n-ypnā' ~μ s l olv-r μy' qtr μ Éyy or qāp' μ r q4

94-4b āyānt' ~' s Klv-r]y' qtr μnz -yr μ v- W -μā' pē lny K° yqv-t L' z -' ~r-ā

Y' lān-q prz r-ā-ā āur z' μā' μ r q ov-qrl v- āur z n-ō snpē lr' s p' -pāā4P lrr-ū' ° μ r t nū rz vā' ~μ' Év-t ā Y' lān-q prz r-ā-ā -l' q' pā' ~ p' lr μ- ā q ā ; fiA+ ' s n-āul' -' tr-yp rz vā' ~μā' yz vā āur v- n-pā' s pyz nā pun-tr 2vā μ z n-qā' lā ā lr q' pr pnlo' ~ rz vā' ~μ n-q ā y' Érl āur LX₈ p' -pr-ānt' ~ v- āur nā' μ-ur l r4 r' ° μ' s μ' -yrz r-āntā prz r-ā-ā μ z nārlvny v- p' -pāā āur q' pr μ LX₈ rz vā' ~μ n-q μā r μ ~-ā r-r Énoy lr μ' ° lr p μ h87389j4 r lr μ' yā v-qvā q' ānt olv-r μy' qtr . o' āu μnz -yr μ/

unū āur -' ā-ā-ā or ° μ r q nū n yz r μā' ~r yxl nārl-āntā q' r ā vā ~r tln-ō y' z r āā n-q vā p' z -' μā' ~4 r yz r μā' ~r yxl vā n-l' q' pā' s āur pl' μāv-t ' s āur yz r μā' ~r l' p x2 Évpu pn- or pnyāp' l' q' y' z vāp4 Rē vā n- r Šārlz r yā ~r -' Éqr l2 Évpu vā Évq r yā ° μ r q nū n yv-t z nārlvny v-prz r-ā-ā p' -pāā 2 n-q z' lānt 2 v-pāā n-q p' z -n-pā-r μ āul' ° t u āur or μā-āntāp r μār qāāvō' ā' ~ h8: j4

r āē' μnz -yr μ pn- or ° μ r q v- nāntāy lr-yp r z r-ā-ā s Y' lān-q prz r-ā-ā n-q āur ~' -μā' pē lny p' -μā' pā' ~ z nārlvny 2μ pu nū nārl o' y' p x μ z ' lānt μān-q olv p x μ h8; j4

r r r pā' s ov-qrl μ Évā qv r lr-ā-ā nāntāp r μār qāāvō' ā' ~μ' ~ prz r-ā-ā n-q z nārlvny Énū lr- l ārq oā V ruq v- l n-q Tunānt h8=j4 Rē nqāvā' ~2 āur μy' qtr μnz -yr μ unā' nū' āur -' ā-ā-ā or ° μ r q nū n purz vnyā lr n-pā-ā ov-qrl 4 r Ln⁸¹ v- ~μ pn- lr n-pā-ā Évā μāyān n-q nū z v-n -lr μr-ā-ā prz r-ā-ā s l z v-t pnyā' z μāyānt μ n-q nū z v-nā μ Évpu ov-q āur r-ā-ā z nū ā tr āur l -l' q' p-v-t n μ yāq r q z nārlvny h: 289j4 O' l āur l 2z nārlvny z' Švq r p' -ā-ā-ā -lr μr-ā-ā olv-r μy' qtr μ pn- pn' μ r n q r pāā v- āur μālv-ānt r μā' ~' s prz r-ā-ā μ z nārlvny v- l' āv-t āur vā μā' pē lny n-q q' lnoyā h8@4

J' -' āur l nqĀn-ānt r v- -lr-ā-ā v- -μā' pē lny ~ z nārlvny Évā āur v-p' l- lānt' ~' s āur āur lr μā' r μ vā ānt āur ā Šp z rāy v- μ -lr μr-ā-ā v- āur z Éyy or v z z' o' yā r q v- āur -lr-ā-ā q' p' z -' μā' 4

94-4b āyānt' ~' s Klv-r]y' qtr μnz -yr μ v- Pr' -' yāz r l vā r K nū r q L' z -' μā' μ

J' tr' -' yāz r l v p' z -' μā' pn- or q r āy- r q oā v-p' l- lānt' v-q' μā' vny Énūā r ° s āyānt' ~' s v-q' μā' vny Énūā ā q r āy- tr' -' yāz r l p' -pāā unū n μā' v pn-ā -' μā' vā v- n-pā' ~ āur r-ā-ā ~ z r-ā-ā n-q' ~ μ' μā' v-noyā v-qvā' l μ h8A97j4

r v-p' l- lānt' ~' s olv-r μy' qtr μnz -yr μ p' -ā-ā v-t pnyā' z pnlo' ~nā 2z nārlvny z uāq l' Švq r 2μ q' v' z pu y l v q r 2 n-q μāyān pn- pn' μ r v- l' āz r-ā-ā v- āur v-ā-ā n-pnyā' ~ qv-t ' s āur tr' -' yāz r l v p' z nārlvny q' r ā āur nqāvā' ~ny s l z nā' ~' s L3] 3Q try' l J 3] 3Q try' tr āur l Évā W3] 3Q' l W3] 3] 3Q5 L3] 3] 3Q try h92; j4 r μz ° yān-r' ° μ -lr μr-ā-ā s āu vā āntā' s tr y μ z' qv r μ āur -uā' pnyā n-q z r pūn-vny -l' -r l ā r μ' s tr' -' yāz r l z nārlvny 4 r l r μā' ° y q or v -l' āz r-ā-ā v- lr μā' v-ā-ā p' z -' lr μā' ~ n-q r Šv' ~ q' r ā āur s l z nā' ~' s q r -μ r z vā' μā' pē lr h9839: j4

r uvt u pnyā' z p' -ā-ā-ā p' -ā-ā v- āur t l r nārl p' z -n-pā' ~' s tr' -' yāz r l μā' pē lr μ4 Lu y l v q r 2' ~ āur ' āur l un-q2 É' l x μ nū n p nāyā' v- l' āv-t āur tr' -' yāz r l vānt' ~ lr n-pā' ~ n-q yāq v-t āur s l z nā' ~' s tr' -' yāz r l v tr y h92; j4 Rē nqāvā' ~2 tr' -' yāz r l z nārlvny nū' unā' āur -' ā-ā-ā v z z' o' yā r ā Šp v- μ -lr μr-ā-ā v- Énūā μā

4. CONCLUSION

r āē' olv-r μy' qtr μnz -yr μ -lr μr-ā-ā q Ln2] v Wn2V t 2 J v l y 2n-q O r v āur vā purz vnyā' z -' μā' ~μā' r z nārlvny p' z -' μā' ~ Énū pnyā' z' s l o' āu μnz -yr μā Rē nqāvā' ~2 āur K]LK nū' -lr μr-ā-ā nārlvny yā nārl -lr μr-ā-ā s J yā r uvt u y' μμ' ~ v-ā-ā ~ -lr μr-ā-ā v- āur purz vnyā' z -' μā' ~' s : 7+ n-q 9=+ s l K]J] n-q K]LK2 lr μr-ā-ā yā pn- or nū' p nā q Évā ā yāntā p' -μā' r-ā-ā n-q āur -lr μr-ā-ā s pnlo' ~nā z nārlvny v- āur lr μā' r μā

h7Bj]v-tu W4K4]v-tu W4Y4O lz nsh' ~ 's LnX sl' z
 surlz ny qrp' z -' lsh' ~ 's nypv' z pno' ~nr v sur
 -lrur-pr 's pno' Sáyp npvq4 S °I-ny 's r lz ny
 J ~nyámu n-q Lny' lz r#á#866@DAB. 7/
 h86j Q' ~t Q° ~Pv2]npxr MroInM4EV ny' ° x ' z nuN4
 J qm' l-sh' ~ 's Éry3 lqrlr q avp' ~v z -u' µ-u' ~nr
 z ° ybnár l yz µ' ~ utu µ' lsnpr nlrn µyprn4Lurz vshá
 's V nsh' lny#7BB7D9. 9/
 h87j M' purµ-r S4j yr l-nsh' µ' --yz r ~shá prz r ~sh' ° µ
 z nr lnyµs' l µ' µsh-voyr p' ~plr sh µ' p' lr µGn lr Áw É
 ' ~ punlnpr lsh' ~ n-q -l' -r lsh' µ d nsh n-q
 K' z ny µc ny' lsh' ~#8686D78. 9/
 h88j Wp' nln J qlv~ R° ~ sh]sh vñ J y Šn-qln Nyr-n2
 c lnorp V vwmz 2 z ° p [' tn- Wñsh2]sh lz]nµ' 2
 XÉ3 n-t L yÁn2 P° xt° ~ V ruz r± J y2 K° ~q° l
 grá-r- KnqIn~2Lv pn R~2c nµy K' tqn~]sh sn-4
 N-q3 s3Usr V nsh' lnyµ b µr q nµ]° --yz r ~shá
 Lrz r ~sh' ° µ V nsh' lnyµ v sur L' ~plr sh
 R-q° µshá4 V nsh' lnyµ#8686D79. A/
 h89j]plvÁr~rl Tnr- U4S u- c n-qrlyrÁ V 4P nsh' rl Nyyµ
 V 4 Np' 3r pr ~sh prz r ~sh Y' sh ~shy rp' ~ z vnyá
 Ánoy µ' y sh ~µ s' l n y É3X8 prz r ~sh µr q
 z nr lnyµ v-q° µshá4 Lrz r ~sh n-q L' ~plr sh
 [rµnlpµ#867AD77:
 h8: j J ° ry V' uz z nq2 Yn-rµIn Mnz n~4 Yuáµpny n-q
 purz vnyr r psh' s yz r µsh ~r yxl' ~ sur uáqlsh' ~
 's µshnz p° lr q prz r ~sh ~sh n-q z ' lsh4 [rÁµsh
 J ULXWYJ a #8686D76. 8/
 h8: j]v-tu]° lán-µu2 Tun~ V nná J ynu2 f nqnÁ c v-v
 T° z nl2 f nqnÁ J xnuµ]v-tu2]unln~ b ~r-qln4
 b shyánsh' ~ 's Klv-r]y qtr v V n° snp° lv-t 's Oá
 J µu Kl vpxµ4 R-sh l-nsh' ~ny S °I-ny 's N-tv-rrlv-t
 MrÁy' -z r ~sh n-q [rµnlpµ#8686DA. 7/
 h8=j V ruqv- ° i Rn n~2Tunánsh Tnz nyQ4N r psh' s ~nlshy
 3nár qvsh' v° sh' ~ n-q µ-rpv p µ' lsnpr nlrn' s qv r lr ~sh
 ov-qr l µásh z µ' ~ -npv-t qr ~shá n-q 'É
 punlnpr lsh' µ' s prz r ~sh ~sh n-q Lrz r ~sh n-q
 L' ~plr sh L' z -' µsh µ#867@D@A
 h8@ P' ~ nyÁµa 4]wAn [4c 4qr Kl vÉ S4Qr l~ ~qrá S4V 4
 Np° v-nµ J 4 [4 Qáqlsh' ~ 's [rnpshÁ V tX nµ
 Ynlshy Lrz r ~sh [r-yprz r ~sh n-q Rµ R° ° r-pr
 ' ~ sur V npl' -rls' lz n-pr 's Lrz r ~sh' ° µ
 V' lsh µ4 J qAn-pr µ v V nsh' lnyµ]pr ~pr n-q
 N-tv-rrlv-t#867BD867B
 h8Aj J ānq W° z n° qqv V 4]nz nlnx' ' ~]4V 4]nz v-qv
 V 4' 4 b shyánsh' ~ 's R-q° µshny Ká3Yl' q° psh
 d nsh sh V n° snp° lr Pr' -' yáz rl Lrz r ~sh
 L' ~plr sh4]° µsh-voysh#8687D79. 8/
 h8Bj U° unl Rz ny2 U° unl]nyz non~° 2 J oq° ynu V' uq
 V° µshn J y Knxl2 Whown rx V nlpv~2]n-q° J ~qlrv
 c vsh l2]āz vqn Sn° µā2 S' lpāá µxn J ~n2 [nānx
 [n ān J oq° v2] āvā Rkz ny Qnxrz J 2 Snz wy W' lv-n
 Qyqná° 2Mrlnz n~ Unyn V nlpnu4] µr µz r ~sh' s sur
]° vshoyshá 's Lrlnz v d nsh v Pr' -' yáz rl
 L' z -' µsh µC ~J --lnyµ4 V nsh' lnyµ#8687D7: . 78/
 h96j V' unwl n~v J oonµ2]° sh MnÁq2 Sr lr á3Knyr á
 a lsh' ~2] ~t a v-án-t2] l° ylnuµ J l° v2Q' l-v° x' x
]° xµ' ~2 UnÉ MnÁq4 [rpápy-t É nsh z nr lnyµ v
 tr' -' yáz rl p' ~plr sh4 L y n~ a rpu~' y' tv µ n-q
 N-Ád' ~z r ~shy Y' y p á#867BD87. 9/

h97j U° unl]nyz non~° 2 Lur~t a n3d ° v2 Wp' yvqr µ
 Mrz r sh µ2 U° unl Rz ny2 Yn-vnu Mvz sh µ2]nxxnµ
 T' ~sh' ~sh' µ4 c ny' lsh' ~ 's tnyµ É nsh
 s' l qrÁy' -z r ~sh 's Pr' -' yáz rl p' z -' µsh µ
 V r pun-vpny -l' -r lsh µ n-q sur' y' t vny
 punlnpr lsh' µC] lr Áw É4L' ~sh' psh' ~ n-q K° yqv-t
 V nsh' lnyµ#867BD886
 h98j P nlpn3U qrv' R2Yny z ' J 4Qr l~ ~qrá3svz ~rā J 4
 V np-urr M4N4L' z ~shoyshá µ' qv µ or sh' r r ~ W3] 3]
 3Q n-q L 3] 3Q tr µ4] sh qá v sur sh l-ná qnt lnz
 Wn8X fl L nX fl J y8X 9fl] v8 fl Q8X 4 Lrz r ~sh n-q
 L' ~plr sh [rµnlpµ#8677D. 7. B/
 h99j f v- Lu lsh' n T4U xrá P ln~sh L 4Yl' Áµ S u- U4Án~
 MrÁr ~sh Sn~w]44N r psh' s nypv' z µyprn µ' ° lpr µ
 ' ~ tr' -' yáz rlsh' ~4 Lrz r ~sh n-q L' ~plr sh
 [rµnlpµ#866ADA. : /
 h9: j P ln~vā' V nln U ā2] y ~µ']n~sh' 2Kyn~p' 3c nlrn
 V nln a 4 Yny z ' J ~try4 J xny-r J psh' sh' ~ 's
 V r shnx' y-CN r psh' s L nypv' z Qáql' Šqr v sur
 Yl' q° psh' s [rnpsh' ~4 S °I-ny 's sur J z rl v n~
 Lrlnz v p] ' pr sh#866: DA. 7/



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