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APPENDICES

Appendix - A

ASTM Test Method of Iodine Adsorption Number

This method covers a procedure for determining the iodine number of carbon blacks. It is indicative of the surface area of black and serves to differentiate between the various grades of carbon blacks.

Equipment:

1. 50ml centrifuge tube with ground glass stopper or suitable alternative
2. Centrifuge or sintered glass crucible, G4
3. 19 x 150mm test tubes
4. 10ml pipettes
5. 25ml pipettes
6. 25ml Burette
7. 50ml Erlenmeyer Flasks
8. Oven
9. Desiccators
10. Analytical Balance
11. 1000 ml Filtering Flask

Reagents:

1. Iodine crystals, A.R.

2. Potassium Iodide, A.R.

3. Sodium Thiosulphate Pentahydrate crystals, A.R.

4. Iodine Solution (Approximately 0.0473N) – Dissolve 6g of Iodine and 57.0g of potassium iodide in 30ml of distilled water in one liter volumetric flask. Shake thoroughly to ensure complete dissolution and then dilute it to 1000ml with distilled water.

5. Sodium Thiosulphate solution (0.0394N) – Dissolve 9.781g of Sodium Thiosulphate Pentahydrate ($Na_2S_2O_3.5H_2O$) in approximately 500ml of distilled water in one liter volumetric flask. Add 5ml of n-methyl Alcohol and dilute 1000ml with distilled water.

6. Starch reagent grade

7. Starch indicator solution – Dissolve 2.5g of starch in 1000ml of distilled water. Boil well to ensure proper solution before storage in bottle.

Procedure:

Standardize the iodine solution as follows:

a). Weigh about 0.2g of Sodium Thiosulphate to nearest 0.0001g.
b). Dissolve in about 50ml of distilled water in 250ml Erlenmeyer flask.
c). Add about 5ml of starch indicator and titrate with the iodine solution until the solution changes from colorless to blue.
d). Record the ml of Iodine solution used and then see "calculations" to determine the normality of the Iodine solution.
e). Run a duplicate determination.

Note: The Iodine solution must be standardized every day or every time used.

1. Dry an adequate sample of carbon black for 1 h at 105deg. C.

2. Cool the dry carbon black in a Desiccator.

3. Weigh exactly 0.5000g of dried sample into a 50ml centrifuge tube.

   Note: For SAF type carbon black weigh a 0.2500g sample.

4. Pipette 25.0ml of Iodine solution into the tube and stopper immediately.

5. Shake the Iodine-carbon black mix vigorously for one minute at no less than 120 strokes per minute.

   Note: Through mixing of carbon black and Iodine solution is necessary.

6. Centrifuge immediately for approximately two minutes.

7. If filtration is used instead of centrifuge, wait for five minutes after shaking, then filter.
   a). Filter with slight suction through a clean, dry, filter crucible into a clean, dry, 19 x 150mm. test tube placed under the end of the crucible holder inside a 1000ml filtering flask.
   b). The end of the crucible holder should be above the surface of the solution in the test tube after filtering.

8. If a centrifuge is used, filtration is not necessary and the solution may be decanted into a 50ml beaker.

9. Immediately after decanting or filtering the Iodine solution into the beaker, pipette 10.0ml into a 50ml Erlenmeyer flask.

10. Titrate the Iodine solution with 0.0394N Sodium Thiosulphate solution until pale yellow colour remains.

11. Add approximately 5ml of the starch indicator solution and continue titrating until one drop of Sodium Thiosulphate solution causes the blue colour to the change to colourless. Record the amount of Sodium Thiosulphate used in the titration.

12. Run duplicate blank determinations by taking 10ml portions of the standard Iodine solution and following steps 10, 11 and 12.

13. See calculations for determining the Iodine number.

Calculations:

1. Normality of Iodine solution = $\frac{\text{Wt. of Sodium Thiosulphate}}{\text{ml of Iodine sol x 0.2482}}$

2. Where 0.5000g sample is used:

   $$I = \frac{B-S}{B} \times N \times 50 \times 126.91$$

   Where 0.2500g sample is used:

   $$I = \frac{B-S}{B} \times N \times 12691$$

Where,

I = Iodine adsorption number in mg of Iodine per g of carbon black.

B = ml of Sodium Thiosulphate solution required for titration of the blank.

S = ml of Sodium Thiosulphate solution required for titration of the sample.

N = Normality of Iodine solution

To simplify calculations, the above formula can be modified as follows:

When the blank titration is carried out 20ml of the Iodine solution is titrated against 0.0394 N Sodium Thiosulphate solution which can be considered as a standard solution.

$\therefore$ N x 20 = B x 0.0394

Hence, substituting "N" in the above formula by $\frac{B \times 0.0394}{20}$

$$I = \frac{(B-S)}{B} \times \frac{B \times 0.0394}{20} \times 12691$$

i.e. I = (B-S) x 25.001

Appendix - B

Designed Tyre Inner Liner Compound Formula for different proportionate in between N330 & PHCB

Different ratios between N330 and PHCB are designed as following tables.

Table A.2.1 Inner Liner Compound formula

Sample 1 (Existing Tyre Inner Liner Formula) **Sample 2**

Ingredient	Std. Wt. (kg)	Batch Wt. (kg)	Ingredient	Std. Wt. (kg)	Batch Wt. (kg)
RSS4	70	0.06417	RSS4	70	0.06417
Reclaim	60	0.05500	Reclaim	60	0.05500
N-330	50	0.04584	N-330	40	0.03667
PHCB	0	0.00000	PHCB	10	0.00917
Process Oil	3	0.00275	Process Oil	3	0.00275
Kaolin	50	0.04584	Kaolin	50	0.04584
Peptizer	0.15	0.00014	Peptizer	0.15	0.00014
ZnO	5	0.00458	ZnO	5	0.00458
Stearic Acid	1	0.00092	Stearic Acid	1	0.00092
6ppd	0.75	0.00069	6ppd	0.75	0.00069
Pine Tar	2	0.00183	Pine Tar	2	0.00183
TBBS	0.9	0.00083	TBBS	0.9	0.00083
Sulphur	2.4	0.00220	Sulphur	2.4	0.00220
TMTD	0.1	0.00009	TMTD	0.1	0.00009
PVI	0.14	0.00013	PVI	0.14	0.00013
TOTAL	**245.44**	**0.225**	**TOTAL**	**245.44**	**0.225**

Table A.2.2 Inner Liner Compound formula

Sample 3			**Sample 4**		
Ingredient	**Std. Wt. (kg)**	**Batch Wt. (kg)**	**Ingredient**	**Std. Wt. (kg)**	**Batch Wt. (kg)**
RSS4	70	0.06417	RSS4	70	0.06417
Reclaim	60	0.05500	Reclaim	60	0.05500
N-330	30	0.02750	N-330	25	0.02292
PHCB	20	0.01833	PHCB	25	0.02292
Process Oil	3	0.00275	Process Oil	3	0.00275
Kaolin	50	0.04584	Kaolin	50	0.04584
Peptizer	0.15	0.00014	Peptizer	0.15	0.00014
ZnO	5	0.00458	ZnO	5	0.00458
Stearic Acid	1	0.00092	Stearic Acid	1	0.00092
6ppd	0.75	0.00069	6ppd	0.75	0.00069
Pine Tar	2	0.00183	Pine Tar	2	0.00183
TBBS	0.9	0.00083	TBBS	0.9	0.00083
Sulphur	2.4	0.00220	Sulphur	2.4	0.00220
TMTD	0.1	0.00009	TMTD	0.1	0.00009
PVI	0.14	0.00013	PVI	0.14	0.00013
TOTAL	**245.44**	**0.225**	**TOTAL**	**245.44**	**0.225**

Table A.2.3 Inner Liner Compound formula

Sample 5			**Sample 6**		
Ingredient	**Std. Wt. (kg)**	**Batch Wt. (kg)**	**Ingredient**	**Std. Wt. (kg)**	**Batch Wt. (kg)**
RSS4	70	0.06417	RSS4	70	0.06417
Reclaim	60	0.05500	Reclaim	60	0.05500
N-330	20	0.01833	N-330	10	0.00917
PHCB	30	0.02750	PHCB	40	0.03667
Process Oil	3	0.00275	Process Oil	3	0.00275
Kaolin	50	0.04584	Kaolin	50	0.04584
Peptizer	0.15	0.00014	Peptizer	0.15	0.00014
ZnO	5	0.00458	ZnO	5	0.00458
Stearic Acid	1	0.00092	Stearic Acid	1	0.00092
6ppd	0.75	0.00069	6ppd	0.75	0.00069
Pine Tar	2	0.00183	Pine Tar	2	0.00183
TBBS	0.9	0.00083	TBBS	0.9	0.00083
Sulphur	2.4	0.00220	Sulphur	2.4	0.00220
TMTD	0.1	0.00009	TMTD	0.1	0.00009
PVI	0.14	0.00013	PVI	0.14	0.00013
TOTAL	**245.44**	**0.225**	**TOTAL**	**245.44**	**0.225**

Table A.2.4 Inner Liner Compound formula
(Only PHCB in place of N330)

Sample 7

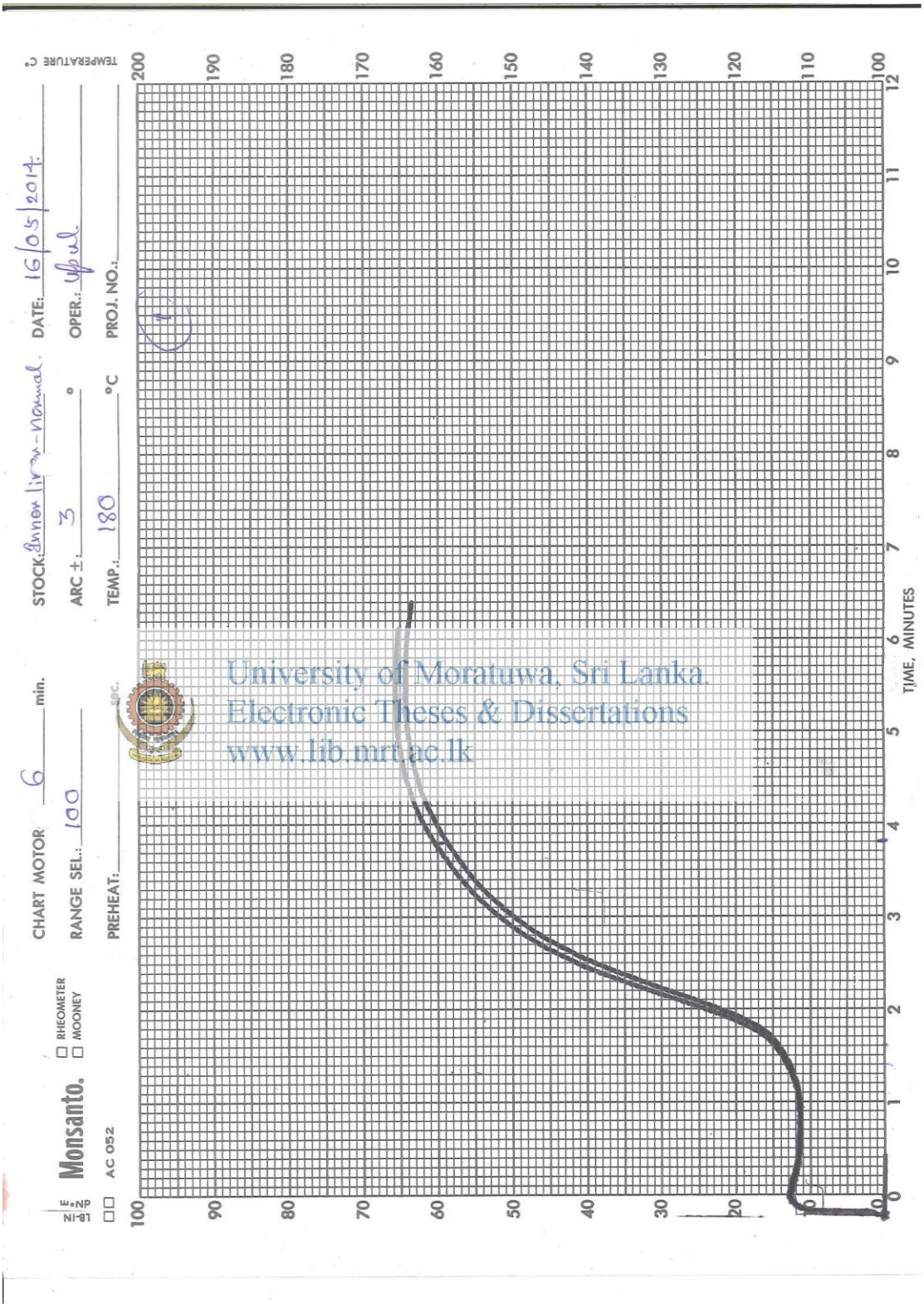
Ingredient	Std. Wt. (kg)	Batch Wt. (kg)
RSS4	70	0.06417
Reclaim	60	0.05500
N-330	0	0.00000
PHCB	50	0.04584
Process Oil	3	0.00275
Kaolin	50	0.04584
Peptizer	0.15	0.00014
ZnO	5	0.00458
Stearic Acid	1	0.00092
6ppd	0.75	0.00069
Pine Tar	2	0.00183
TBBS	0.9	0.00083
Sulphur	2.4	0.00220
TMTD	0.1	0.00009
PVI	0.14	0.00013
TOTAL	**245.44**	**0.225**

Appendix - C

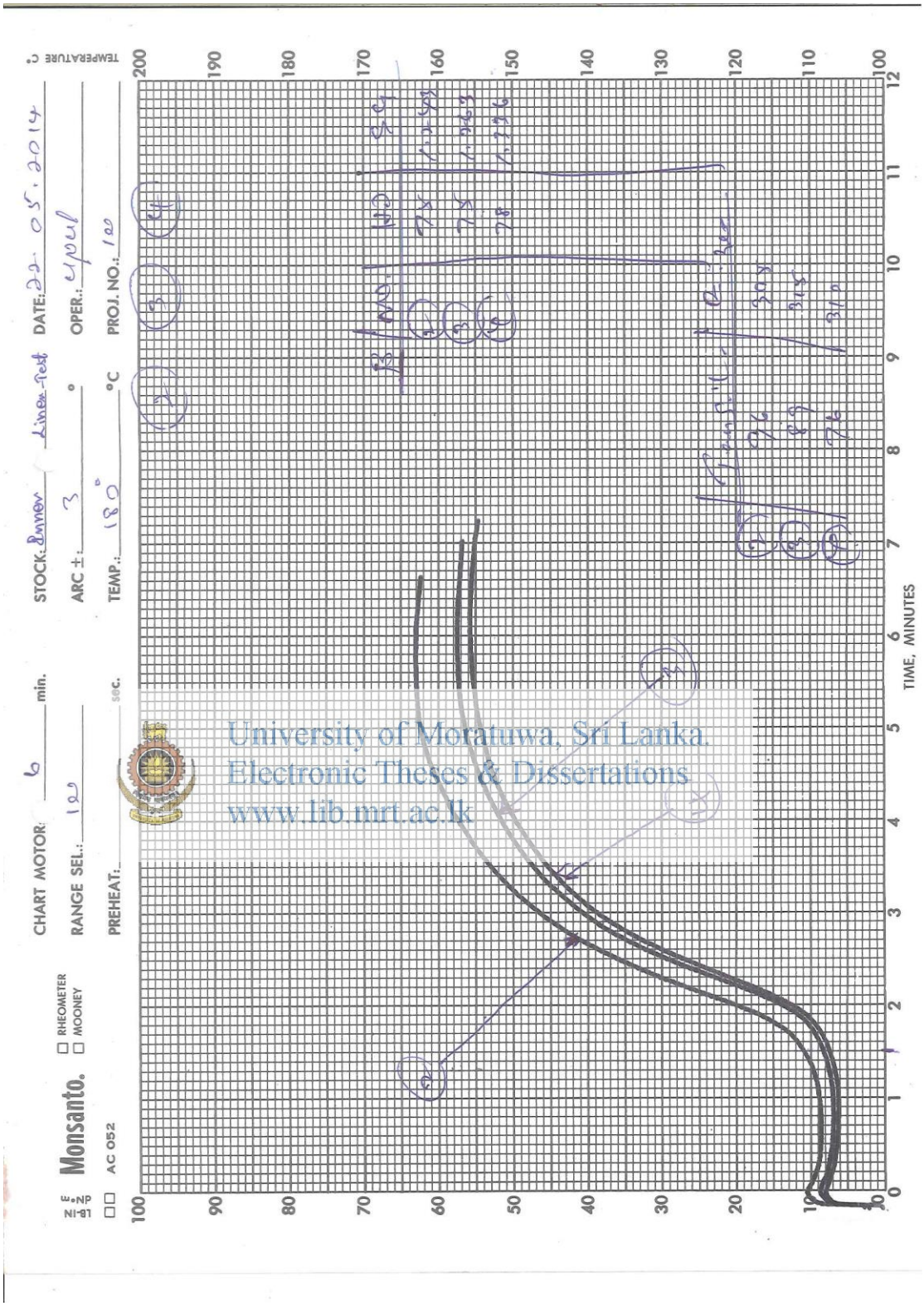
Cost Saving Calculation PHCB Usage for inner liner compound

1kg Price for N330	180	LKR
1kg Price for PHCB	75	LKR
N330 kg per batch existing formula (Sample 1)	50	kg
N330 kg per batch new formula (Sample 3)	30	kg
PHCB kg per batch new formula (Sample 3)	20	kg
Existing formula (Sample 1)- N330 per batch cost	9000	LKR
New formula (Sample 1)- N330 and PHCB per batch cost	6900	LKR
Per batch saving	2100	LKR
Per kg Saving	8.61	LKR
Monthly average inner liner compound consumption	6000	kg
Monthly total saving	51639	LKR

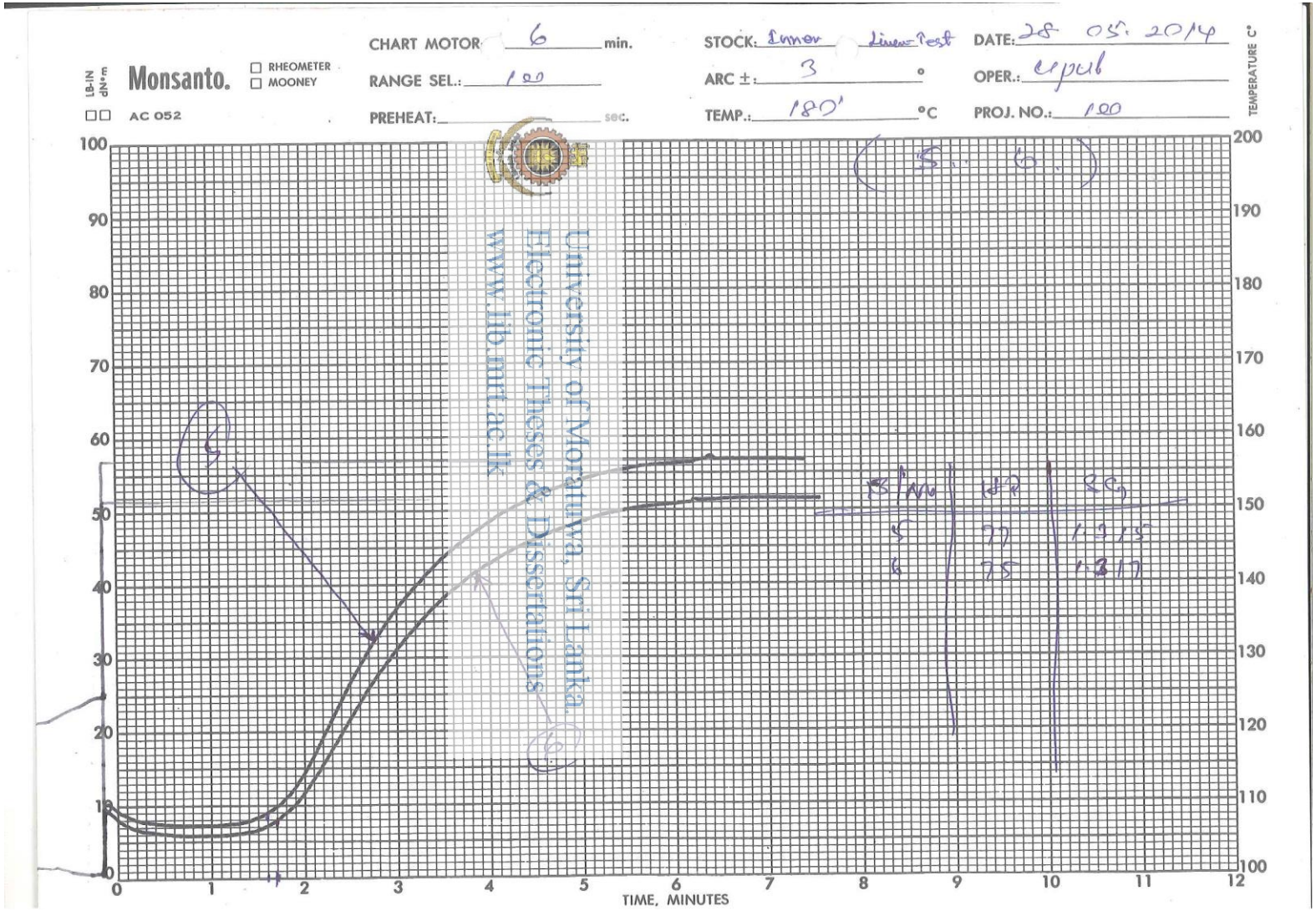
Appendix - D



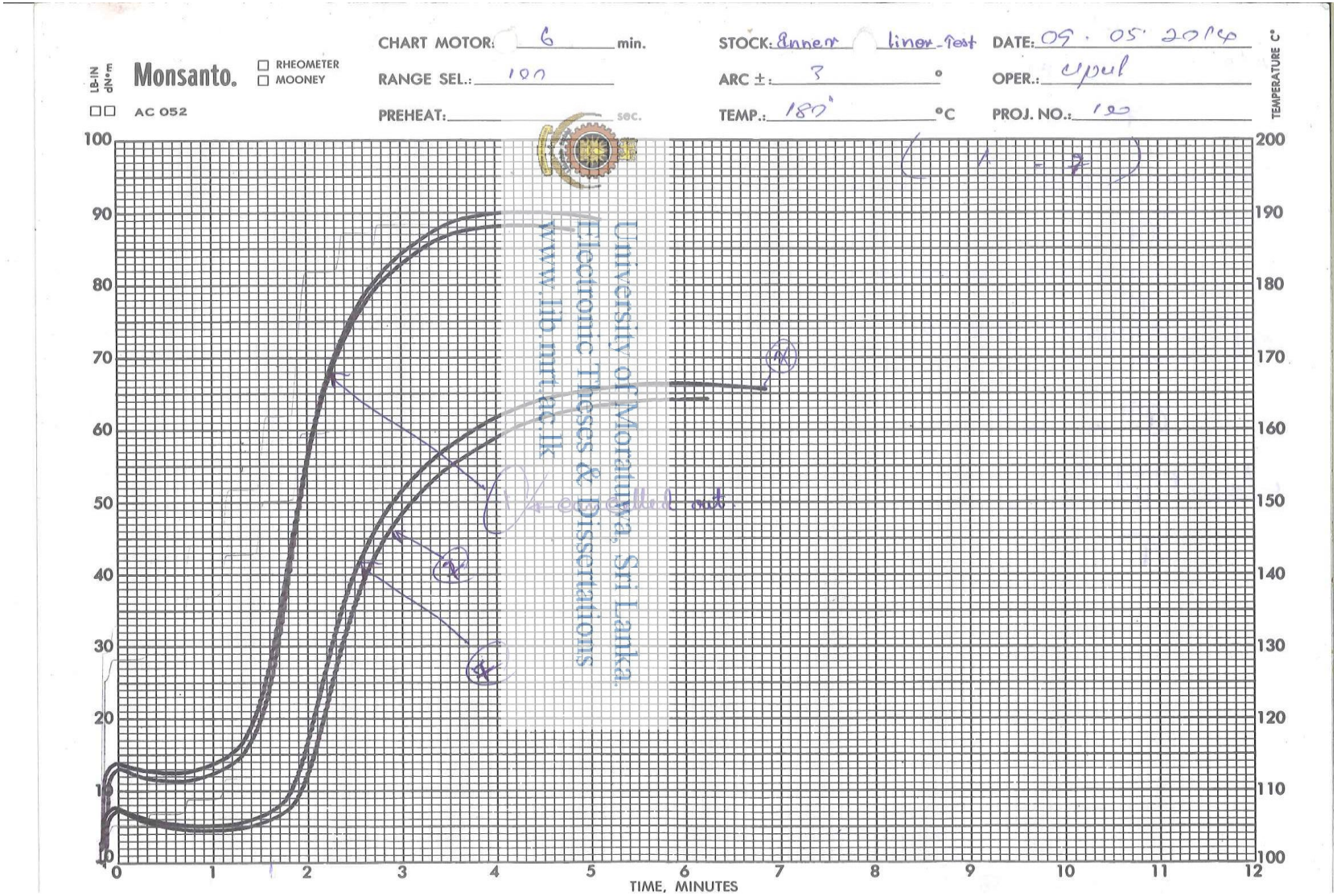
Rheo-graph – Sample 1



Rheo-graph – Sample 2,3,4



Rheo-graph – Sample 5,6



Rheo-graph – Sample 7