

**Savage
Resources
Limited**

89-2979^{R/F}



TASMANIAN OCHRES A SUPPLEMENTARY REPORT TO THE
 ANNUAL REPORT
 RETENTION LICENCE 8802 BOWRY CREEK
 SAVAGE RIVER, TASMANIA
 for the period
 23rd May 1988 to 23rd May 1989

by John A Hosking

Marafield Pty Ltd

89-2979

MINES	
File Ref. RL 8802	
30 JUN 1989	
Doc. Ref.	
Action Officer	Initials
LETTER	
23.6.89	
REFERS	
Resubmit to	Date

CONTENTS

	Page No
Contents	2
1.0 Introduction	4
2.0 Testing Procedure	5
2.1 Sample Preparation	5
2.2 Preliminary Testing	5
2.3 Routine Testing	7
3.0 Pigment Preparation	8
3.1 Sizing	8
3.2 Paint formulations	8
3.3 Sample paint preparation	9
3.4 Sample disc preparation	10
4.0 Colour Measurement and Data Analysis	11
4.1 Colour measurement technique	11
4.2 Colour field choice	11
4.3 Plotting Results	12

5.0 Commentary on Results and Further Work Required 13

5.1 Ancillary investigations 14

Appendices - Sample discs, tables and graphs

1.0 INTRODUCTION

This supplementary report documents the conclusion of phase one investigation of sixteen ochre samples supplied by Henry Shannon. The initial report was based on work carried out on only six of these samples and the results of the remaining ten samples and some further investigative work is documented here.

2.0 TESTING PROCEDURES

2.1 Sample Preparation

Raw ochre sample was weighed and dried in a convection oven. This took 36 to 48 hours to achieve zero moisture.

The dried sample was split, one half retained and the other ball milled. The milled product was again split and half of it calcined.

2.2 Preliminary testing

Before commencing routine work, it was necessary to establish the ball milling time and the calcination temperature to be used.

Initially grinding was carried out using a 300 mm diameter unlined steel ball mill, which we constructed for the purpose. However the first trial resulted in the ochre charge plastering the inside of the mill with little or no grinding. To overcome this the mill was fully lined with 3mm linatex sheeting. This cured the initial problem but resulted in excessive coating of the balls. Although the moisture of the charge was measured at only 1%, this

appeared to be the cause of the problem and on re - drying the problem disappeared. The sample in question had been left in the cold oven over the weekend and the uptake of atmospheric moisture over this time was sufficient to impede grinding. All further samples were kept in the hot oven until loaded into the mill.

A sample of ochre was milled for 1Hr, 2Hrs, 4Hrs, 8Hrs, 16Hrs, and 32Hrs and samples checked for colour parameters and diluted colour parameters. The chroma level increased with increased grinding time but as the increase was only marginal above 8Hrs, we accepted this as the practical optimum for the system and standardised at this level.

Calcination is used to convert the hydrated yellow ochres to red colours and to establish the calcination temperature, a sample was calcined at 250 C, 300 C, 350 C, and 400 C. The chroma levels and colour angle were then measured. Colour angle decreased (moved towards red) as the temperature was increased to 350 C and then stabilised. The chroma level decreased significantly when 300 C was exceeded, we standardised on 300 C. However some fine tuning around this temperature may be beneficial.

2.3 Routine Testing

Based on the above information, we established the following routine testing procedure.

- a) Weigh out two samples of 3.5 Kilos each
- b) Dry these at 120 C for at least 36 hours or until 0% moisture.
- c) Charge the mill with 65 Kg graded balls and one sample (circa 2.5 Kilos).
- d) Mill for 8Hrs.
- e) Split the milled sample and charge the cold calciner.
- f) Raise the calciner to 300 C and cut off gas (2Hrs).
- g) Allow to cool naturally and remove.

3.0 PIGMENT PREPARATION

3.1 Sizing

As the batch milling process did not allow classification to be used, some standard system was required to remove any tramp oversize prior to testing pigmentation properties. At a later stage, air classification will be used to generate ultrafine fractions which will conform closely to commercial sizing. However at this stage it was felt that simply screening at 100 um would allow rapid and reproducible comparisons of the ochre range.

3.2 Paint Formulations

Previous testing of ochres had relied on powder colour measurements and one dilution at 10%. This system had its disadvantages in that the samples themselves were hard to store or transport and were of little use for marketing studies.

For this study we decided to use a paint medium as the vehicle for pigment evaluation and to examine a far wider range of dilutions.

The paint selected for this study was a low sheen acrylic formulation with titanium dioxide as the sole pigment. The general formulation is as follows:-

Filler (Calcite)	136 grams / litre
Extender (Kaolin)	44 grams / litre
Pigment (TiO ₂)	323 grams / litre

We decided to progressively substitute ochre pigment for titanium dioxide up to 160 grams / litre.

3.3 Sample Paint Preparation

A master batch of paint was produced for each sample as follows:-

- a) Weigh up 2.2 grams kaolin
 6.8 grams calcite
 16.15 grams ochre
- b) Disperse this batch in 43 mls. of acrylic resin base with 1 ml Dispex, using high speed laboratory mixer for 5 min..
- c) Add 50 mls. of Low sheen white acrylic paint and re - mix
- d) Remove 50 ml aliquot and store (160 grams / litre)
- e) Add 50mls white paint and re - mix etc.
- f) Continue with dilutions until final sample at 10 grams /

litre is taken.

This results in 5 samples at pigment loadings of 10, 20, 40, 80, & 160 grams per litre.

3.4 Sample disc Preparation

A 10 ml aliquot of sample paint was transferred to an inking tray and a 60 ml sponge roller evenly charged with the paint. The paint was then laid on a bond paper which was backed with double sided tape.

Sets of disks were cut from the dried paper using a wad punch and were then mounted on the prepared forms.

4.0 COLOUR MEASUREMENT AND DATA ANALYSIS

4.1 Colour Measurement Technique

The instrument used for colour measurement was a Minolta Chromameter. This is self contained unit with a measuring head using a xenon source and the ability to report the data on a number of scales or even on the Munsell colour chart. Prior to a measurement run the unit is standardised against a colour tile and then each disc is measured in turn using the triple measurement and averaging function of the unit.

4.2 Colour Field Choice

As stated above, the unit can report on a number of scales. For good colour measurement the choice lies between the Lab system and the LCH system. The former measures brightness (L) and red and yellow co-ordinates and is probably the more useful for production control. The second system uses radial co-ordinates to describe colour, reducing it to a colour strength and a hue angle which are directly comparable between samples and were selected for this evaluation stage.

4.3 Plotting Results

The data was transferred to a P.C. using a Supercalc 3.0 spreadsheet programme which enables the automatic production of graphs of the data. As the work proceeds, regression programmes will be introduced to reduce dilution relationships to mathematical formulae for use in designing blending programmes for colour matching.

The output of this programme is appended as tables for each of the ten samples examined to date and graphs of the performance of both natural and calcined pigments.

5.0 COMMENTARY ON RESULTS AND FURTHER WORK REQUIRED

The visual examination of the sample discs is carried out in the light of the fact that, in commercial paint production, what are referred to as "mid" colours are produced using a coloured pigment loading of 60 grams / litre.

Against this subjective standard nine of the ten samples performed extremely well. Another subjective comment may be made about the colour range which covers reds, pinks yellows, creams, and lilac and dove greys. In many cases, even though the absolute chroma level was quite low, it was persistent and together with the inherent darkness of the sample, generated a very pleasing warm grey tone. A more objective view may be expressed in terms of colour angle which ranges from 39.0 to 90.9 covering 14.5% of the total colour spectrum.

As stated earlier, of the sixteen samples examined, only one, TT1/5 could be considered a failure, it was in fact just a lightly stained talc with very low colouring power and poor persistence when diluted. The others all have their

merits.

Although the pigmenting power varies considerably even the worst result shows a chroma retention of 40% when diluted 16 times while the best gives a result of 60% at the same dilution! It is likely that these results will be further improved by finer grinding.

5.1 Ancillary Investigations

During such an investigation, it is inevitable that a number of ancillary lines of enquiry come to mind. One obvious one is the use of high energy bead mills for the final dispersion of the pigments into paint or other media, there is a move at the present time for some paint companies to move away from micronised (jet milled) pigments and used lower cost milled pigments by incorporating fluid bead milling in the manufacturing circuit. To investigate this angle, we have built a small bead mill and run one initial trial. Unfortunately, the short cut method we tried, dispersing directly into the acrylic resin base, resulted in excessive medium breakdown and we will have to virtually simulate actual paint production. To this end B.A.S.F. have been most useful in supplying base formulae, and we will follow up this aspect in future work.

A second thought which occurred was to carry out calcination

procedures in an oxygen free atmosphere, mainly to see if we could produce a different colour. The method we came up with to achieve this was simple and effective. The calcining charge was loaded together with two pellets of pure naphthalene, known to the layman as moth balls! These vaporise at very low temperature and flush out the calcining chamber.

The sample chosen for the trial was HT5/1, a sample of strong colour. The result was unexpected and exciting, the colour angle changed only marginally, but the chroma level improved by 35% and the persistence of the pigment at 16 times dilution improved from 59% to 64%

We have been unable to find any mention of this effect in the literature.

In order to verify the phenomenon, we ran a second trial using MT1/1, one of the lilac greys with relatively low chroma. The result this time was less dramatic but still highly significant. Chroma improved by 17% and persistence at 16 times dilution improved from 52% to 54%.

It is unlikely that one shot in the dark has achieved the ultimate, but it has opened the door to research to further enhance what we believe to be excellent natural pigments.

We now intend to carry out the following supplementary programme on the same samples.

1.0 Establish parameters for three pigments at the yellow end, red end, and middle of the existing range.

2.0 Endeavour to manufacture these by blending.

3.0 Using these three blended feeds examine the effects of:

a) Small changes in calcination temperatures

b) Very high grinding energy inputs, using the bead mill.

c) Further verify the naphthalene effect on blended samples.

d) Trial other solid reagents, both reducing and oxidising during calcination.

Following these studies, further large samples will be required for the production of market samples for pilot trials. These are currently being obtained by Henry Shannon. A parallel study will examine the effectiveness of the pigment as a cement colourant.

APPENDIX I
SUMMARY OF NATURAL PROPERTIES
FOR ALL SAMPLES EXAMINED
Samples are listed in order of
Sample No.
Brightness
Chroma
Hue Angle
Pigmenting power

TASMANIAN OCHRE PROJECT

SUMMARY OF NATURAL DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME LEVEL	CHROMA	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
---------------	----------------------------------	--------	-------	---------------------------------------

HT3/2	86.2	21.6	86	71
HT5/1	85.7	22.5	85.8	68
HT5/5	85.4	16	78.9	65
MT1/1	76.1	7.3	46.8	71
MT2/3	79.4	9.8	69.1	79
MT3/6	79.3	9.7	79.6	70
MT4/6	86.4	17.4	86.1	69
MT5/4	82.3	19.3	79.6	70
TT1/1	87.2	14.9	83.9	63
TT1/2	85.8	17.5	81.7	65
TT1/5	91.1	5.9	86.3	56
TT1/8	90.7	10.6	84.9	60
TT4/6	85.8	18	84.4	67
LP2/6	85.6	14.7	80.8	67
BT1/1	74.9	6.5	71.4	75
BT1/6	73.4	7.1	70.9	77

TASMANIAN OCHRE PROJECT

SUMMARY OF NATURAL DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME LEVEL	CHROMA	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
---------------	----------------------------------	--------	-------	---------------------------------------

TT1/5	91.1	5.9	86.3	56
TT1/8	90.7	10.6	84.9	60
TT1/1	87.2	14.9	83.9	63
MT4/6	86.4	17.4	86.1	69
HT3/2	86.2	21.6	86	71
TT1/2	85.8	17.5	81.7	65
TT4/6	85.8	18	84.4	67
HT5/1	85.7	22.5	85.8	68
LP2/6	85.6	14.7	80.8	67
HT5/5	85.4	16	78.9	65
MT5/4	82.3	19.3	79.6	70
MT2/3	79.4	9.8	69.1	79
MT3/6	79.3	9.7	79.6	70
MT1/1	76.1	7.3	46.8	71
BT1/1	74.9	6.5	71.4	75
BT1/6	73.4	7.1	70.9	77

TASMANIAN OCHRE PROJECT

SUMMARY OF NATURAL DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME	CHROMA LEVEL	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
------------------	----------------------------	-----------------	-------	---------------------------------------

MT2/3	79.4	9.8	69.1	79
BT1/6	73.4	7.1	70.9	77
BT1/1	74.9	6.5	71.4	75
HT3/2	86.2	21.6	86	71
MT1/1	76.1	7.3	46.8	71
MT5/4	82.3	19.3	79.6	70
MT3/6	79.3	9.7	79.6	70
MT4/6	86.4	17.4	86.1	69
HT5/1	85.7	22.5	85.8	68
TT4/6	85.8	18	84.4	67
LP2/6	85.6	14.7	80.8	67
TT1/2	85.8	17.5	81.7	65
HT5/5	85.4	16	78.9	65
TT1/1	87.2	14.9	83.9	63
TT1/8	90.7	10.6	84.9	60
TT1/5	91.1	5.9	86.3	56

APPENDIX II
SUMMARY OF CALCINED PROPERTIES
FOR ALL SAMPLES EXAMINED
Samples are listed in order of
Sample No.
Brightness
Chroma
Hue Angle
Pigmenting power

TASMANIAN OCHRE PROJECT

SUMMARY OF CALCINED DATA

SAMPLE NUMBER	BRIGHTNESS	CHROMA	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
	AT 40 GRAMME LEVEL			
HT3/2	73	23.5	54.2	79
HT5/1	75.4	18	51.4	78
HT5/1R	70.7	23.5	51.2	80
HT5/5	73.9	13.4	43.8	78
MT1/1	74	7.9	39	79
MT1/1R	72.8	9.1	44.1	76
MT2/3	75.8	10.1	48	77
MT3/6	73.8	9	53.8	73
MT4/6	78.4	13.7	51.4	76
MT5/4	69.6	17.4	46.7	78
TT1/1	79.6	15.2	53.5	68
TT1/2	75.1	18.2	52.9	73
TT1/5	88.2	7.1	67.8	60
TT1/8	83.5	11.4	59.4	69
TT4/6	74.2	18.5	52.6	73
LP2/6	75.3	13.5	48.7	73
BT1/1	70	3.7	41.7	73
BT1/6	70.1	4.2	46.3	77

TASMANIAN OCHRE PROJECT

SUMMARY OF CALCINED DATA

SAMPLE NUMBER	BRIGHTNESS	CHROMA	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
	AT 40 GRAMME LEVEL			
TT1/5	88.2	7.1	67.8	60
TT1/8	83.5	11.4	59.4	69
TT1/1	79.6	15.2	53.5	68
MT4/6	78.4	13.7	51.4	76
MT2/3	75.8	10.1	48	77
HT5/1	75.4	18	51.4	78
LP2/6	75.3	13.5	48.7	73
TT1/2	75.1	18.2	52.9	73
TT4/6	74.2	18.5	52.6	73
MT1/1	74	7.9	39	79
HT5/5	73.9	13.4	43.8	78
MT3/6	73.8	9	53.8	73
HT3/2	73	23.5	54.2	79
MT1/1R	72.8	9.1	44.1	76
HT5/1R	70.7	23.5	51.2	80
BT1/6	70.1	4.2	46.3	77
BT1/1	70	3.7	41.7	73
MT5/4	69.6	17.4	46.7	78

TASMANIAN OCHRE PROJECT

SUMMARY OF CALCINED DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME	CHROMA LEVEL	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
------------------	----------------------------	-----------------	-------	---------------------------------------

HT3/2	73	23.5	54.2	79
HT5/1R	70.7	23.5	51.2	80
TT4/6	74.2	18.5	52.6	73
TT1/2	75.1	18.2	52.9	73
HT5/1	75.4	18	51.4	78
MT5/4	69.6	17.4	46.7	78
TT1/1	79.6	15.2	53.5	68
MT4/6	78.4	13.7	51.4	76
LP2/6	75.3	13.5	48.7	73
HT5/5	73.9	13.4	43.8	78
TT1/8	83.5	11.4	59.4	69
MT2/3	75.8	10.1	48	77
MT1/1R	72.8	9.1	44.1	76
MT3/6	73.8	9	53.8	73
MT1/1	74	7.9	39	79
TT1/5	88.2	7.1	67.8	60
BT1/6	70.1	4.2	46.3	77
BT1/1	70	3.7	41.7	73

TASMANIAN OCHRE PROJECT

SUMMARY OF CALCINED DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME	CHROMA LEVEL	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
------------------	----------------------------	-----------------	-------	---------------------------------------

MT1/1	74	7.9	39	79
BT1/1	70	3.7	41.7	73
HT5/5	73.9	13.4	43.8	78
MT1/1R	72.8	9.1	44.1	76
BT1/6	70.1	4.2	46.3	77
MT5/4	69.6	17.4	46.7	78
MT2/3	75.8	10.1	48	77
LP2/6	75.3	13.5	48.7	73
HT5/1R	70.7	23.5	51.2	80
HT5/1	75.4	18	51.4	78
MT4/6	78.4	13.7	51.4	76
TT4/6	74.2	18.5	52.6	73
TT1/2	75.1	18.2	52.9	73
TT1/1	79.6	15.2	53.5	68
MT3/6	73.8	9	53.8	73
HT3/2	73	23.5	54.2	79
TT1/8	83.5	11.4	59.4	69
TT1/5	88.2	7.1	67.8	60

TASMANIAN OCHRE PROJECT

SUMMARY OF CALCINED DATA

SAMPLE NUMBER	BRIGHTNESS AT 40 GRAMME	CHROMA LEVEL	ANGLE	RATIO OF 20 GRAMME TO 80 GRAMME
------------------	----------------------------	-----------------	-------	---------------------------------------

HT5/1R	70.7	23.5	51.2	80
HT3/2	73	23.5	54.2	79
MT1/1	74	7.9	39	79
HT5/1	75.4	18	51.4	78
HT5/5	73.9	13.4	43.8	78
MT5/4	69.6	17.4	46.7	78
MT2/3	75.8	10.1	48	77
BT1/6	70.1	4.2	46.3	77
MT1/1R	72.8	9.1	44.1	76
MT4/6	78.4	13.7	51.4	76
TT1/2	75.1	18.2	52.9	73
TT4/6	74.2	18.5	52.6	73
LP2/6	75.3	13.5	48.7	73
BT1/1	70	3.7	41.7	73
MT3/6	73.8	9	53.8	73
TT1/8	83.5	11.4	59.4	69
TT1/1	79.6	15.2	53.5	68
TT1/5	88.2	7.1	67.8	60

APPENDIX III

DATA FOR FINAL TEN SAMPLES

Colour charts

Digitised colour data sheets

Graphs of natural and calcined data

025

TASMANIAN OCHRE PROJECT

SAMPLE NO :- BT 1/1

MILLED:- 8 HRS
CALCINED: 300 C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	1	1	1	1	1	1	1	1	
Chroma	1	1	1	1	1	1	1	1	1	
Angle	1	1	1	1	1	1	1	1	1	
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	
Brightness	1	1	1	1	1	1	1	1	1	
Chroma	1	1	1	1	1	1	1	1	1	
Angle	1	1	1	1	1	1	1	1	1	

107027

107028

026

TASMANIAN OCHRE PROJECT

SAMPLE NO:- BT1/1

MILLED:-
CALCINED:

8 HRS
300 C

TOTAL PIGMENT LOADING
323 g/l

MINUS 100µm FRACTION

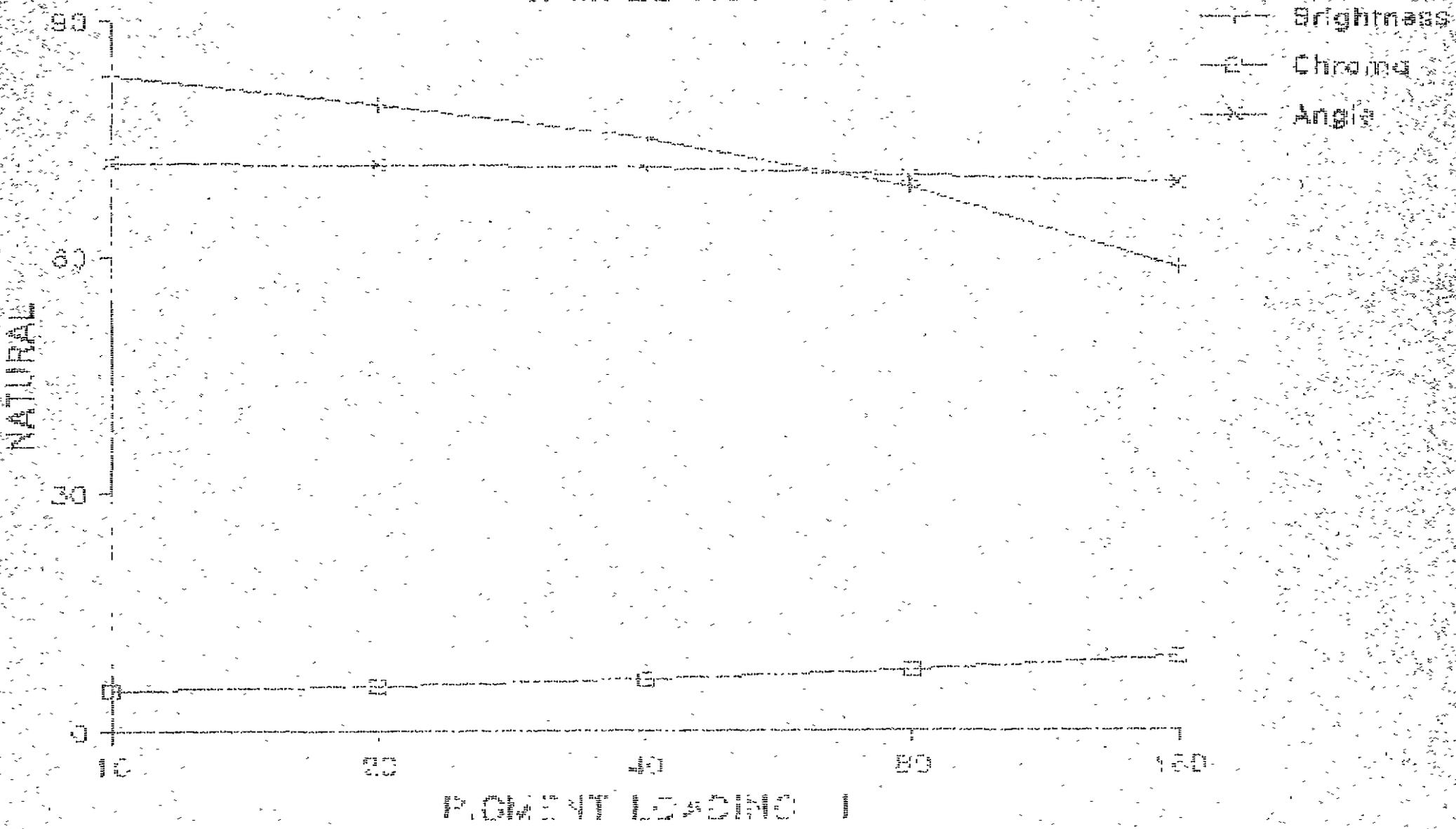
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	83	1	79.3	1	74.9	1	68.7	1	58.6
Chroma	1	5.1	1	5.8	1	6.5	1	7.7	1	9.5
Angle	1	71.9	1	71.7	1	71.4	1	70.1	1	69.2
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	79.9	1	75.5	1	70	1	63	1	52.2
Chroma	1	2.8	1	3.2	1	3.7	1	4.4	1	5.3
Angle	1	45.1	1	40.2	1	41.7	1	42.7	1	45

107029

027

TASMANIAN COCHINEAL PROJECT

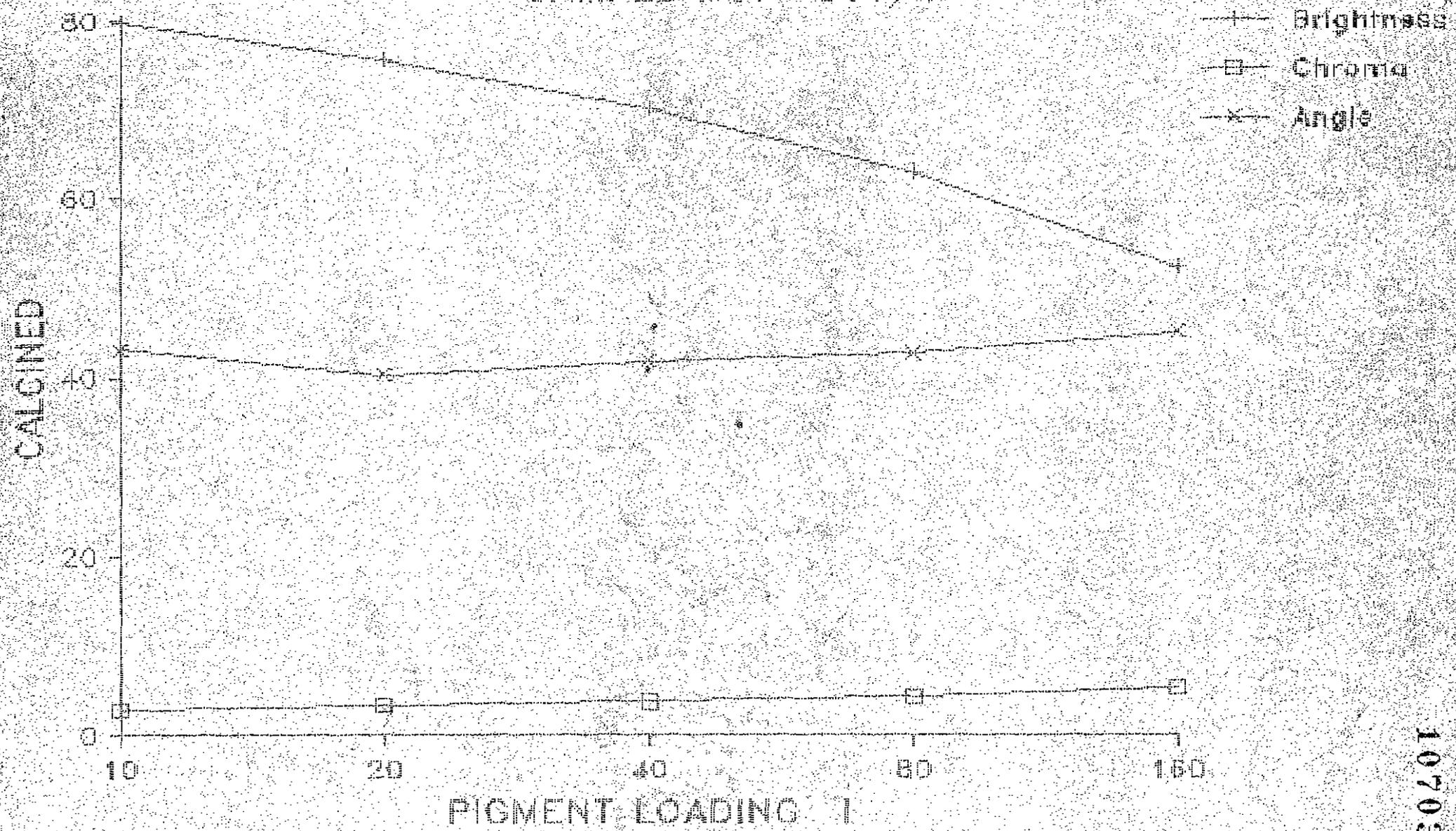
SAMPLE NO. 44



TASMANIAN OCHRE PROJECT

SAMPLE NO: BT1/1

028



107030

107032

030

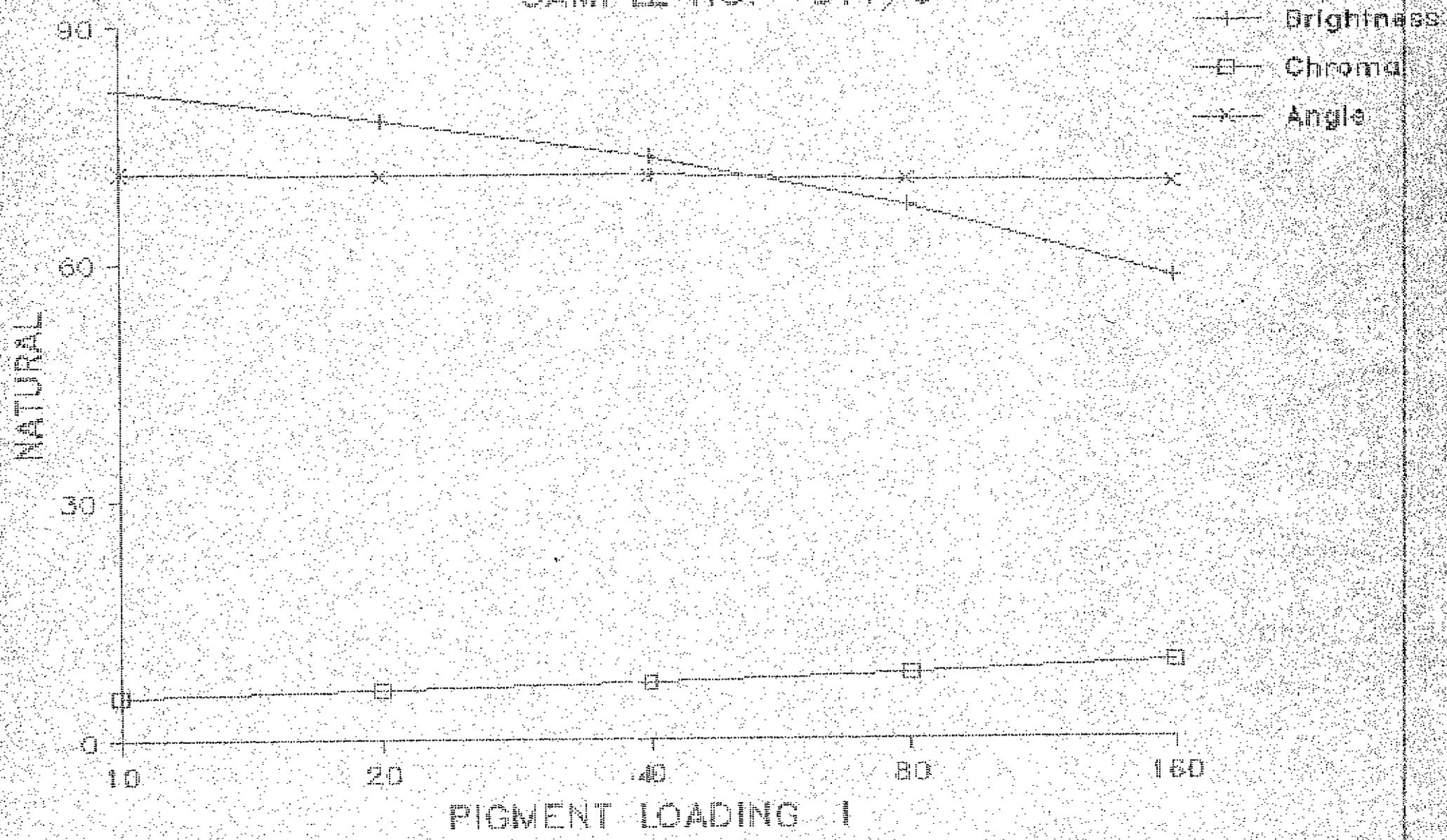
TASMANIAN OCHRE PROJECT

SAMPLE NO:- BT1/6 MILLED:- 8 HRS TOTAL PIGMENT LOADING
 MINUS 100um FRACTION CALCINED: 300 C 323 g/l

SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightnes	1	81.8	1	77.8	1	73.4	1	67	1	57.9	1
Chroma	1	5.5	1	6.4	1	7.1	1	8.3	1	9.7	1
Angle	1	71.3	1	70.9	1	70.9	1	70.2	1	69.8	1
PIGMENT LOADING grams/litre	1		1		1		1		1		1
	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightnes	1	78.2	1	74.6	1	70.1	1	62.7	1	53.1	1
Chroma	1	3.3	1	3.6	1	4.2	1	4.7	1	5.6	1
Angle	1	47.3	1	46.8	1	46.3	1	47.6	1	48.5	1

TASMANIAN OCHRE PROJECT

SAMPLE NO: - BT1/6

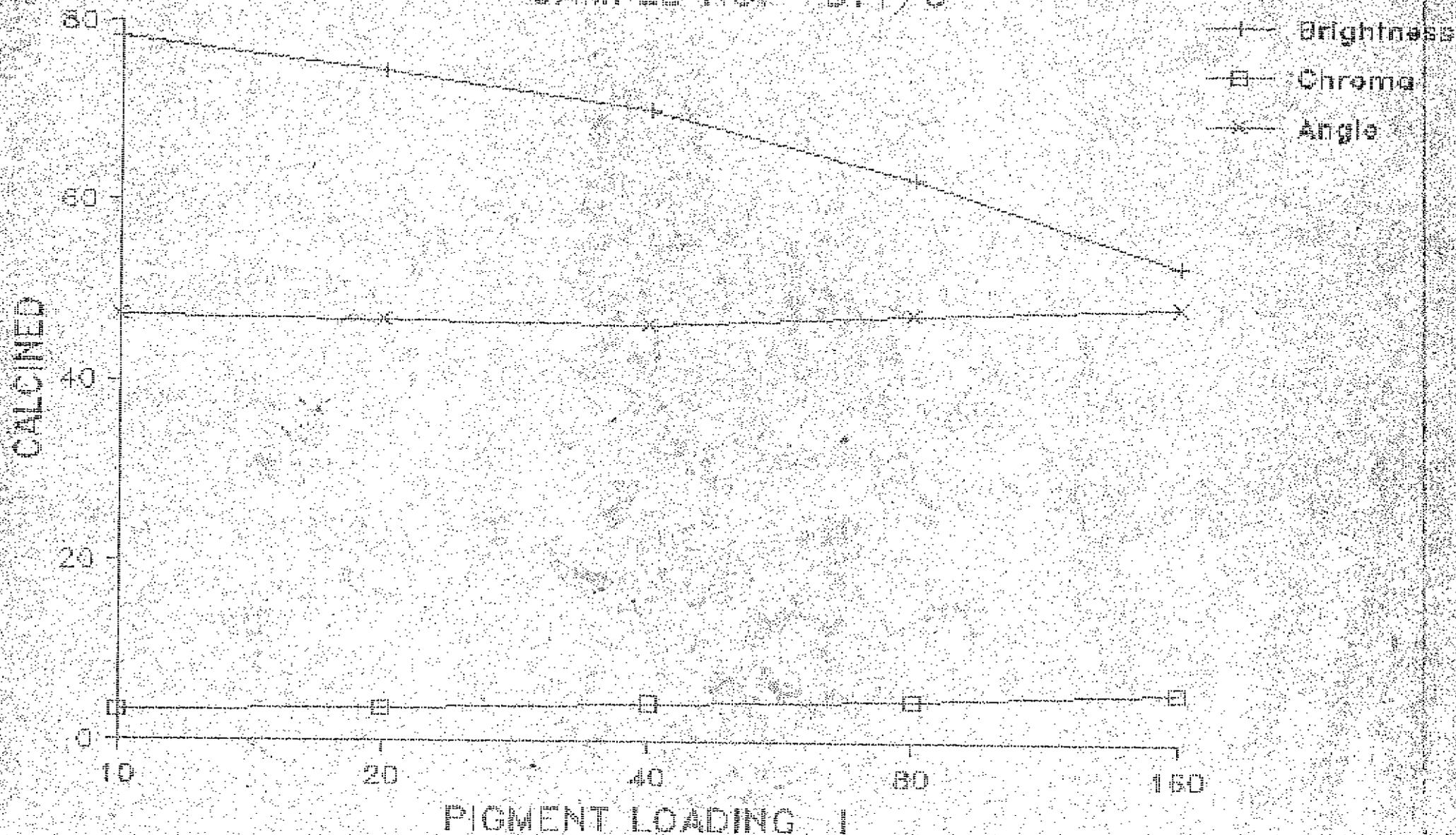


TASMANIAN OCHRE PROJECT

107034

032

SAMPLE NO:- BT1/6



107036

TASMANIAN OCHRE PROJECT

SAMPLE NO:- LP2/6

MILLED:-
CALCINED:

8 HRS
340 C

TOTAL PIGMENT LOADING
323 g/l

MINUS 100um FRACTION

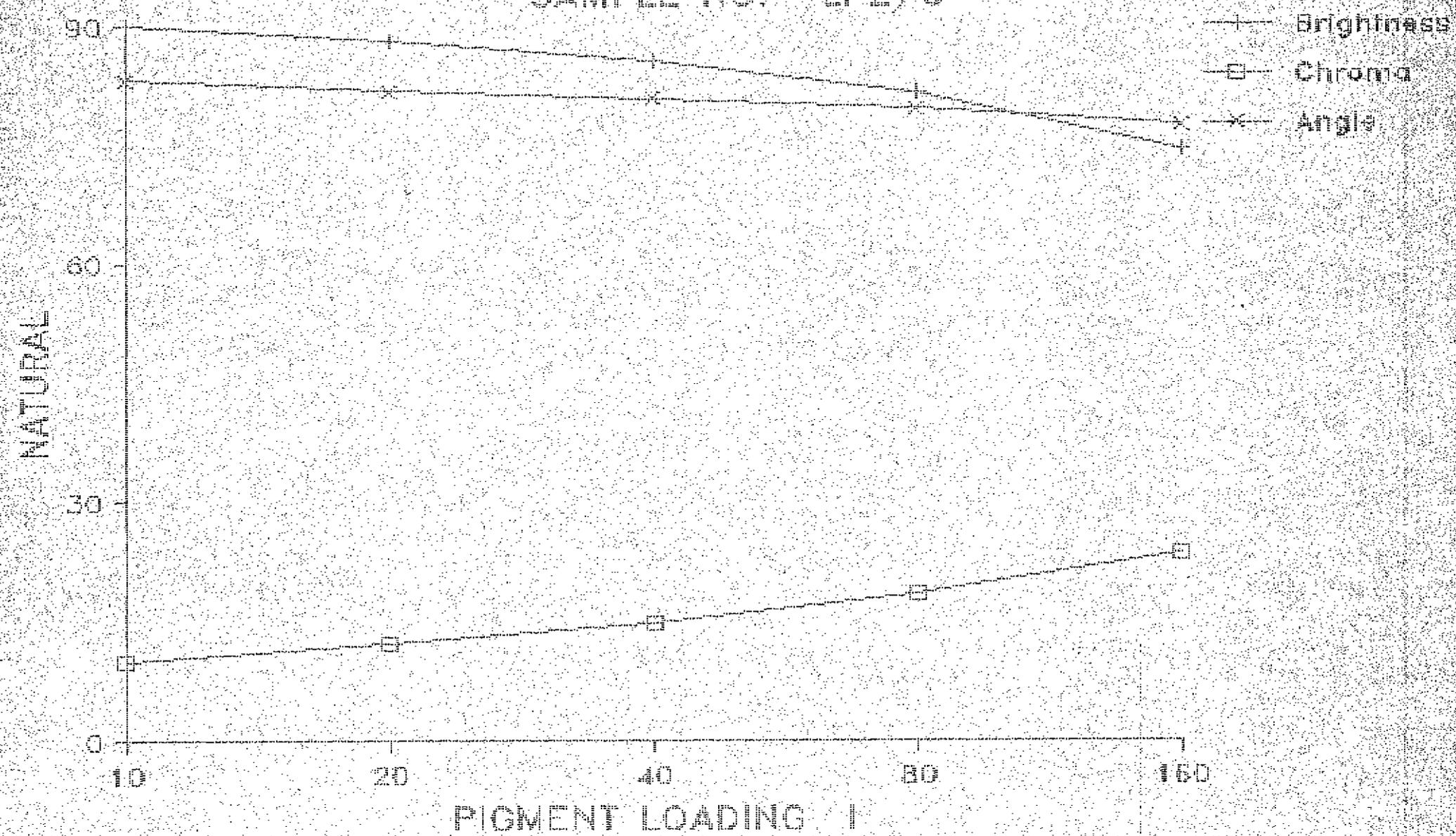
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightnes	1	90	1	88	1	85.6	1	81.4	1	74.3
Chroma	1	10	1	12.3	1	14.7	1	18.4	1	23.7
Angle	1	83.2	1	81.7	1	80.8	1	79.5	1	77.5
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightnes	1	83.1	1	79.7	1	75.3	1	69	1	59.5
Chroma	1	10	1	11.8	1	13.5	1	16.2	1	19.2
Angle	1	50.7	1	49.5	1	48.7	1	48.4	1	49

107037

035

TASMANIAN OCHRE PROJECT

SAMPLE NO:- LP2/6

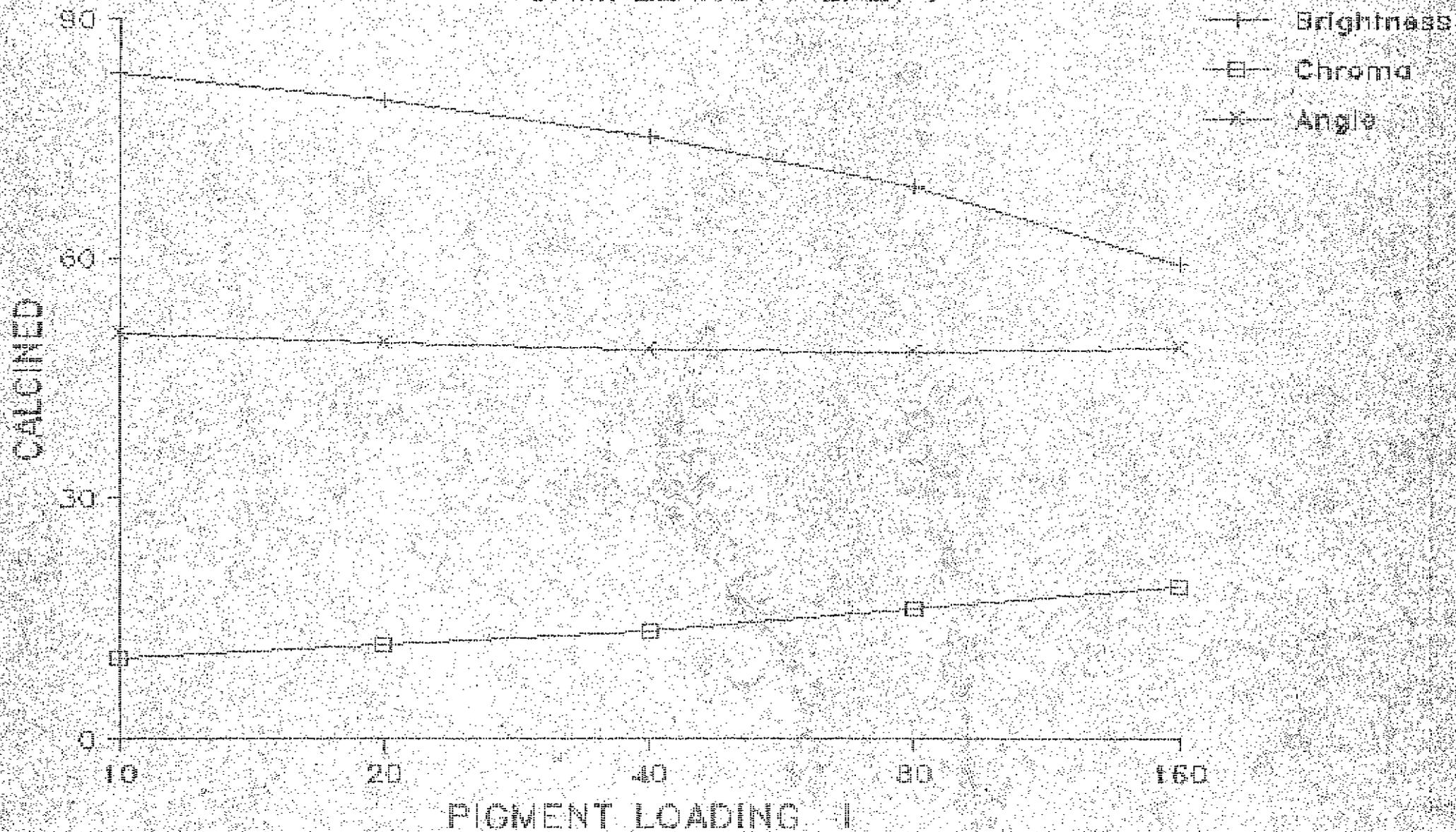


107038

0
12
53

TASMANIAN OCHRE PROJECT

SAMPLE NO - LP2/6



107039

4.0

TASMANIAN OCHRE PROJECT

SAMPLE NO :- HT 3/2

MILLED:- 8 HRS
CALCINED: 300 C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1
PIGMENT LOADING grams/litre	1	1	1	1	1	1	1	1
	10	20	40	80	160			
CALCINED	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1

107040

800

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT3/2

MILLED:-
CALCINED:

8 HRS
340 C

TOTAL PIGMENT LOADING
323 g/l

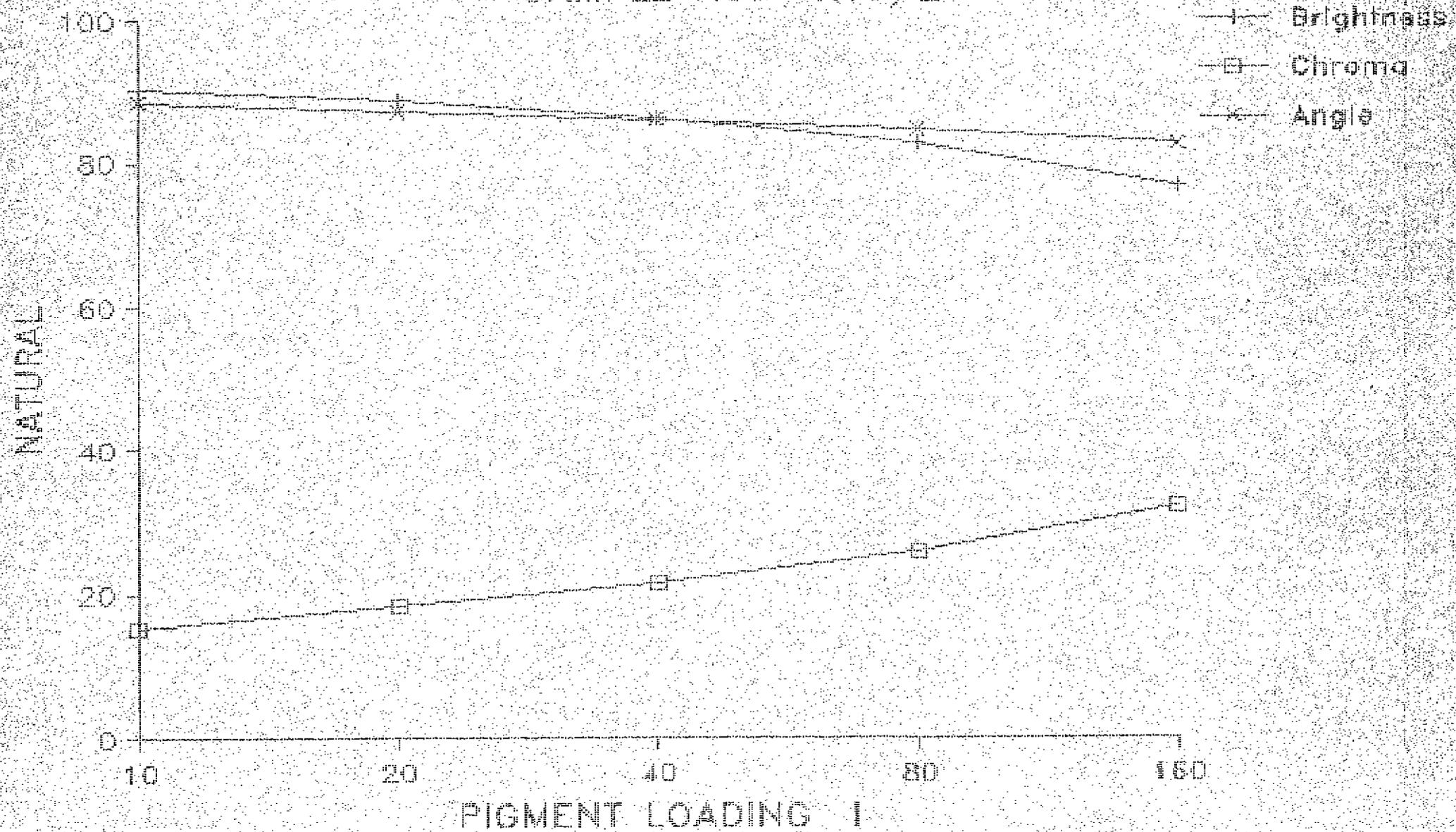
MINUS 100um FRACTION

SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	90.2	1	88.6	1	86.2	1	82.8	1	76.8	1
Chroma	1	15.3	1	18.3	1	21.6	1	25.9	1	32.2	1
Angle	1	88.5	1	87.1	1	86	1	84.6	1	82.6	1
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	79.8	1	76.8	1	73	1	67.9	1	59.5	1
Chroma	1	18.4	1	20.6	1	23.5	1	26.1	1	29.5	1
Angle	1	55.9	1	55.2	1	54.2	1	53.5	1	52	1

107041

TASMANIAN OCHRE PROJECT

SAMPLE NO: HT3/2

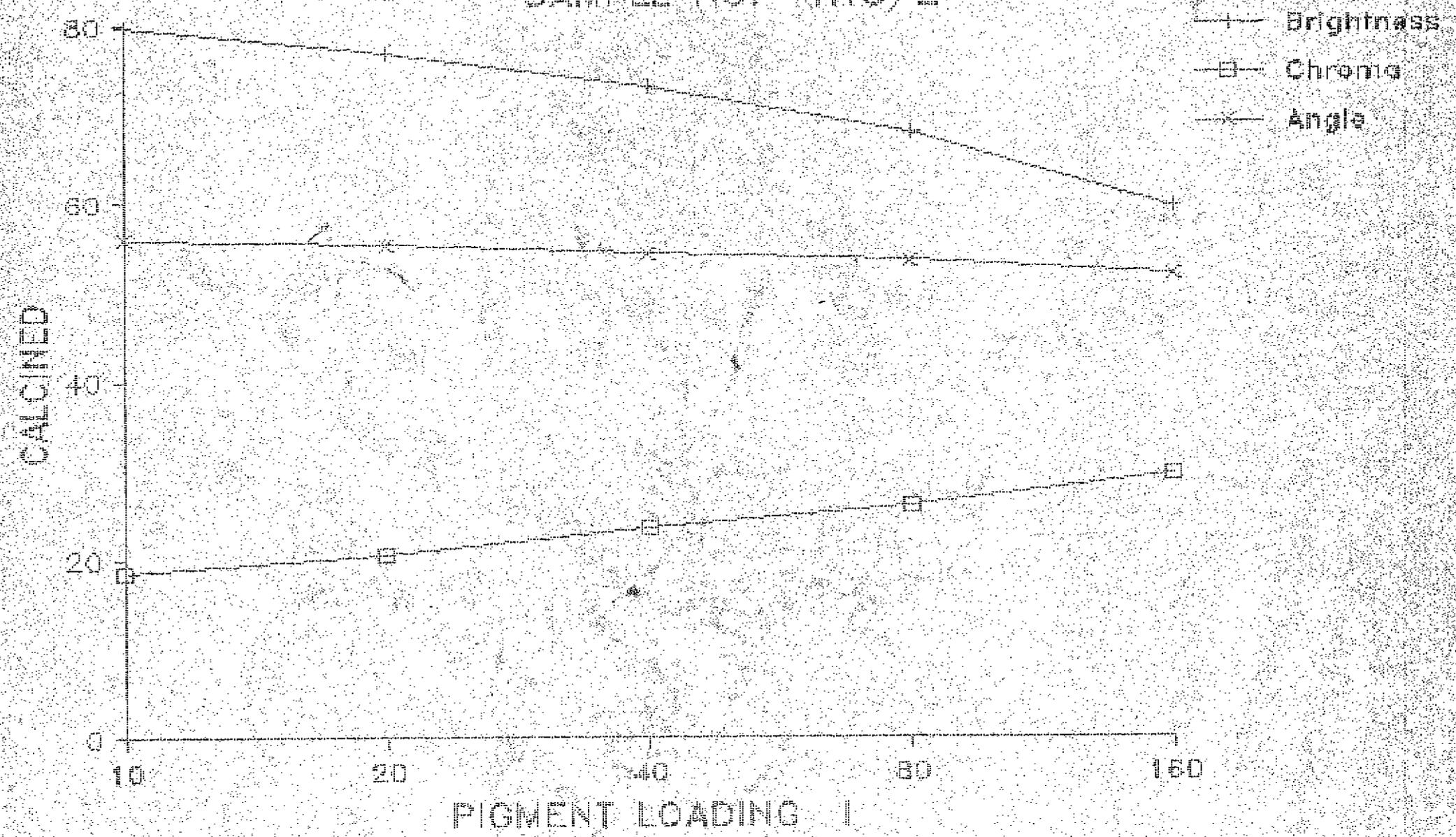


107042

TASMANIAN OCHRE PROJECT

SAMPLE NO: - HT3/2

040



107044

042

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/2

MILLED:-
CALCINED:8 HRS
300 CTOTAL PIGMENT LOADING
323 g/l

MINUS 100um FRACTION

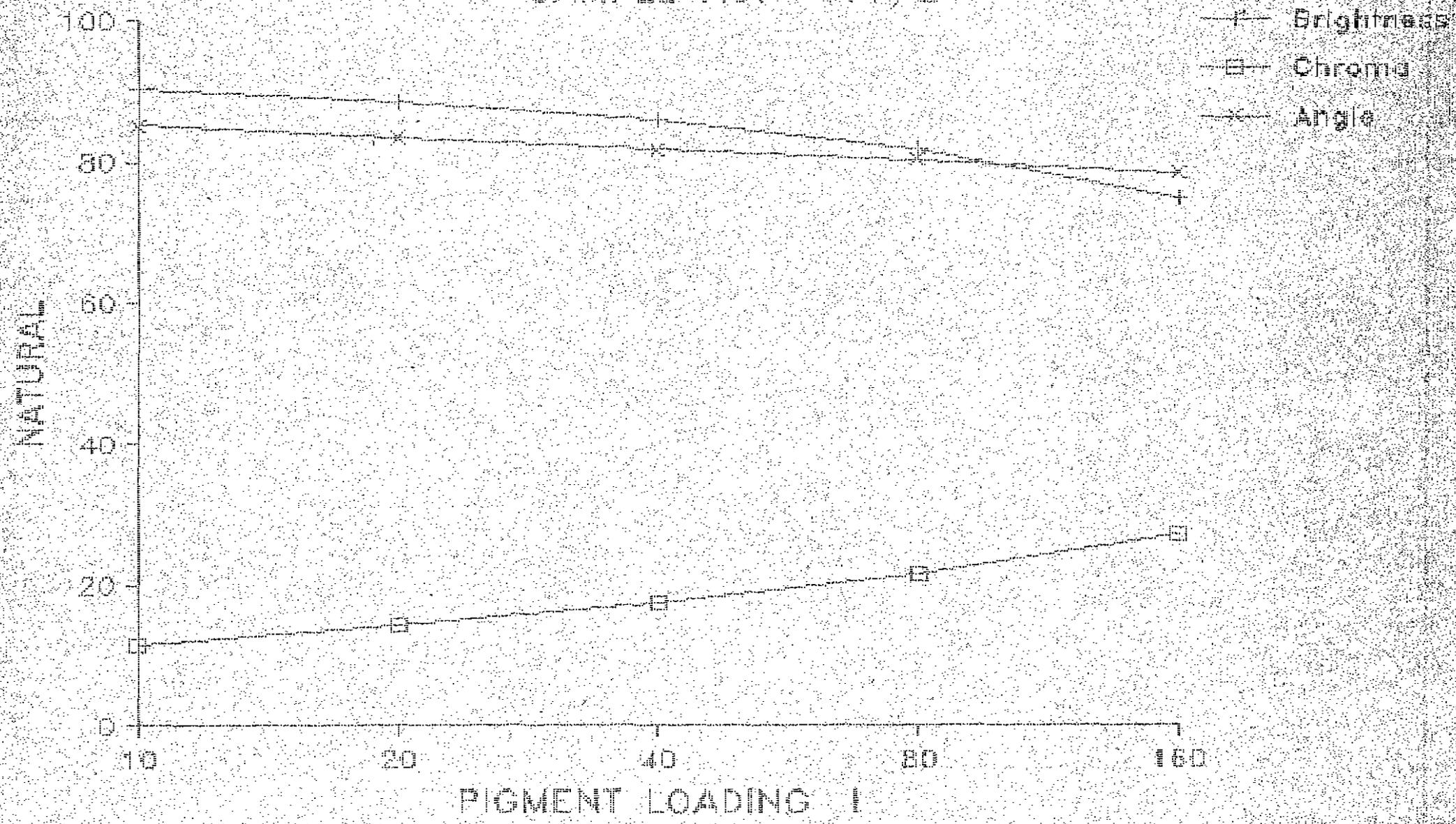
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightnes	1	90.2	1	88.5	1	85.8	1	81.7	1	74.9
Chroma	1	11.5	1	14.1	1	17.5	1	21.6	1	27.3
Angle	1	85.1	1	83.3	1	81.7	1	80.2	1	78.4
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightnes	1	82.9	1	79.5	1	75.1	1	68.9	1	59.5
Chroma	1	13	1	15.5	1	18.2	1	21.1	1	24.7
Angle	1	55.5	1	54.3	1	52.9	1	52.3	1	50.4

107045

TASMANIAN OCCHIRE PROJECT

SAMPLE NO: - TT1/2

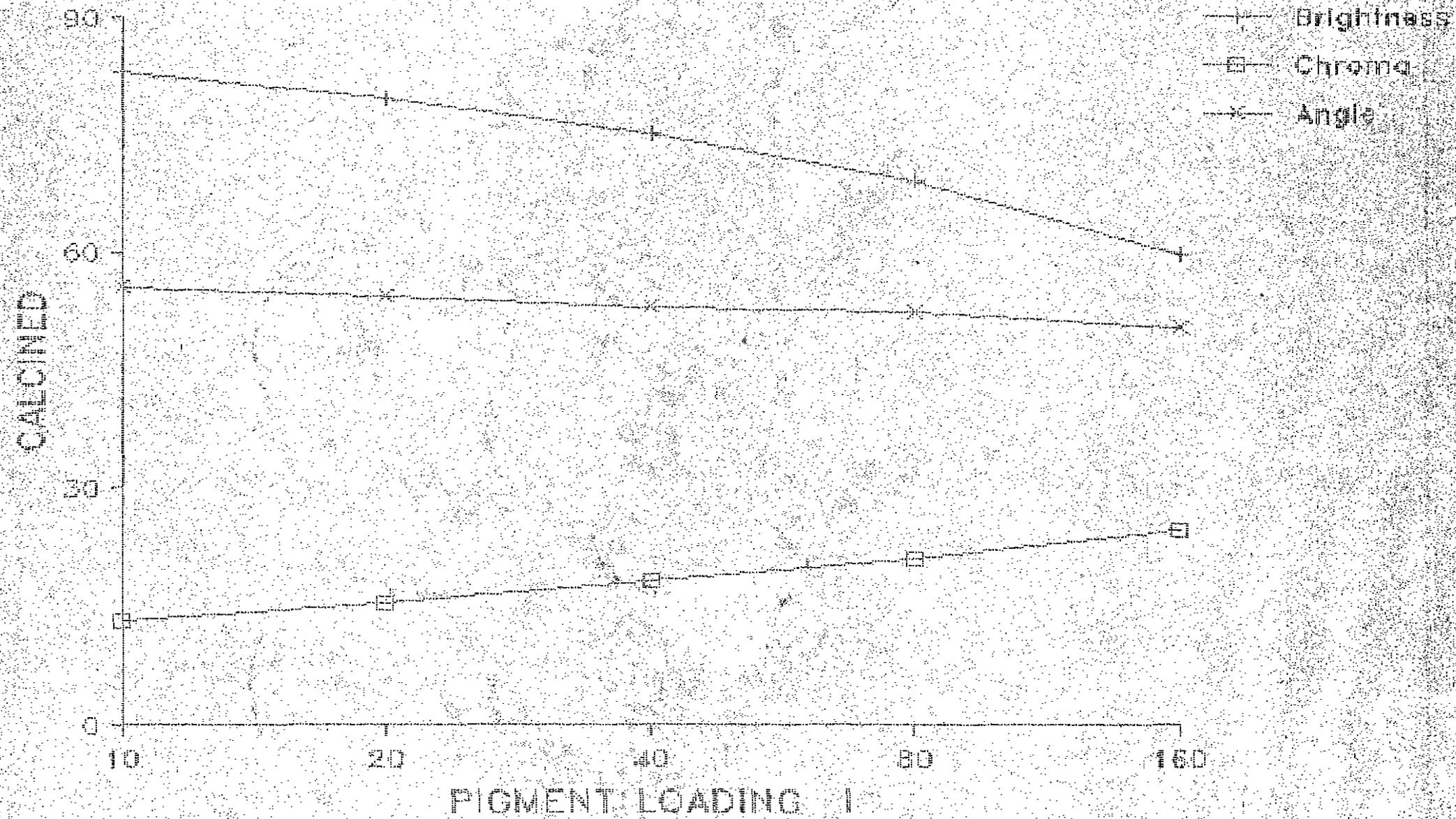
043



TASMANIAN OCHRE PROJECT

041

SAMPLE NO: TT1/2



107048

025

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/5

MILLED:-
CALCINED:8 HRS
300 CTOTAL PIGMENT LOADING
323 g/l

MINUS 100um FRACTION

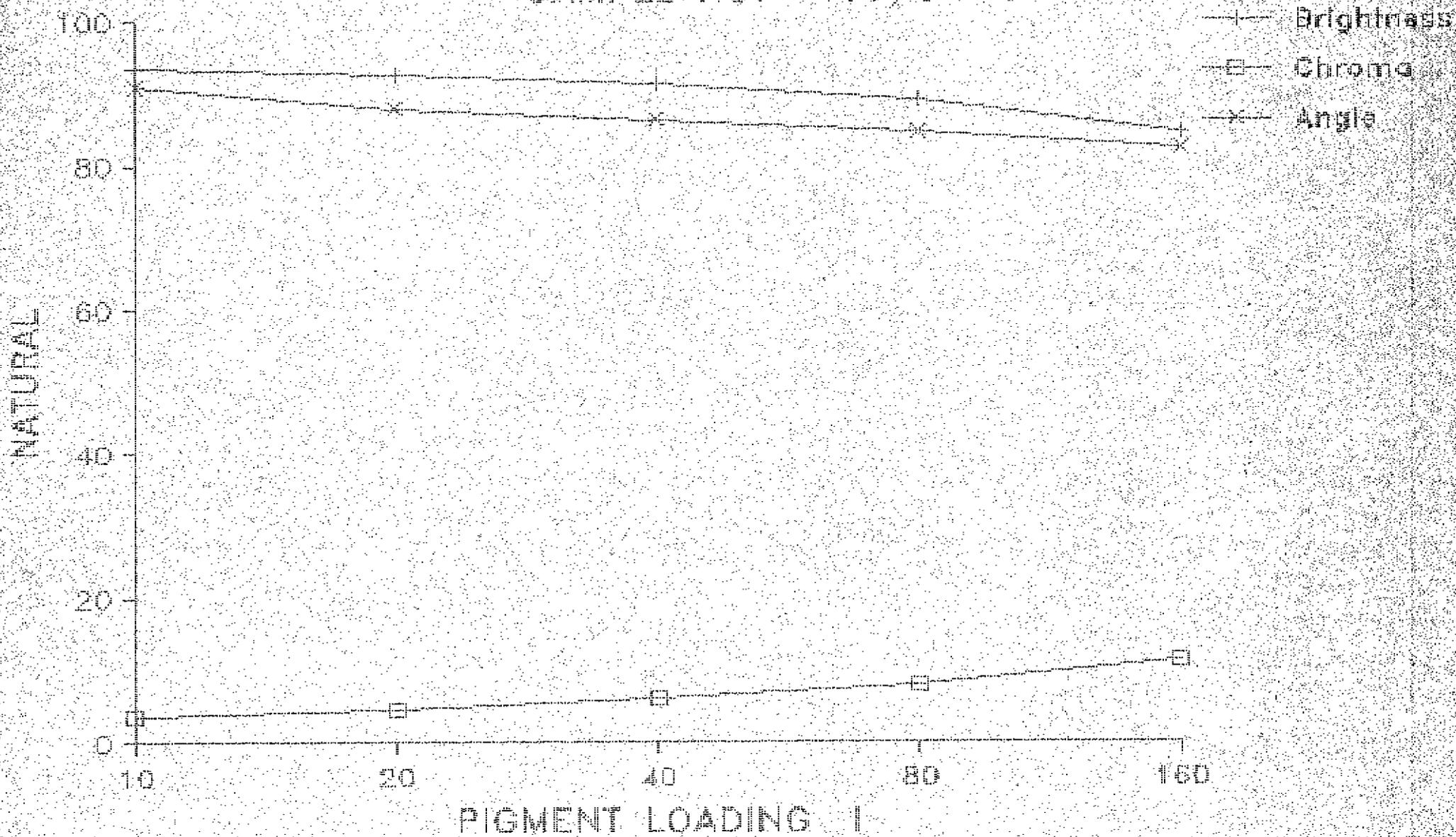
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	93.4	1	92.5	1	91.1	1	88.9	1	84.6
Chroma	1	3.5	1	4.5	1	5.9	1	8	1	11.5
Angle	1	90.9	1	87.8	1	86.5	1	84.6	1	82.4
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	91.4	1	90.2	1	88.2	1	85.2	1	79.4
Chroma	1	4.3	1	5.5	1	7.1	1	9.2	1	13
Angle	1	73.7	1	70.5	1	67.8	1	65.8	1	64.3

107049

TASMANIAN OCHERE PROJECT

047

SAMPLE NO:- TT1/5

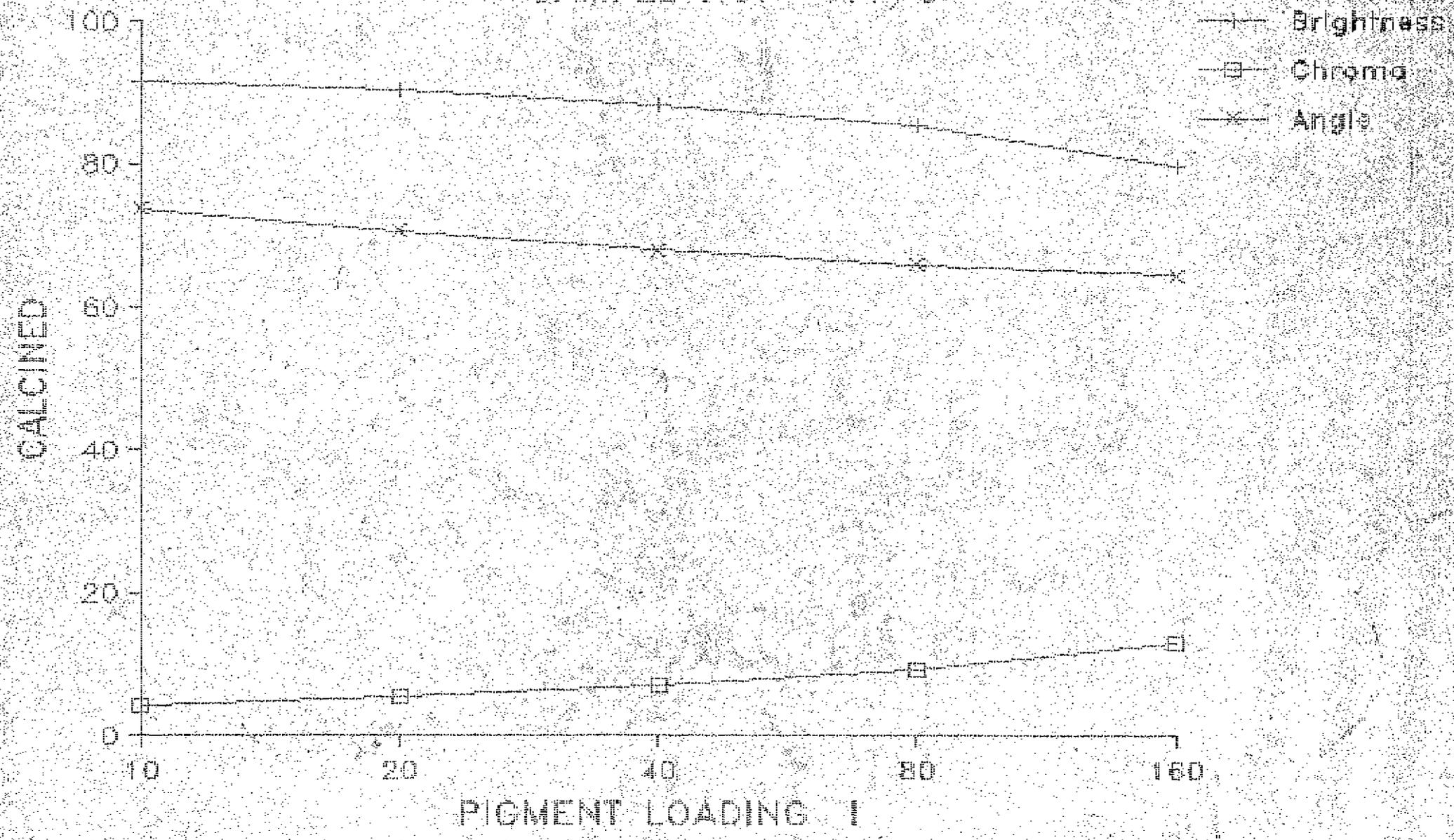


107050

TASMANIAN OCHRE PROJECT

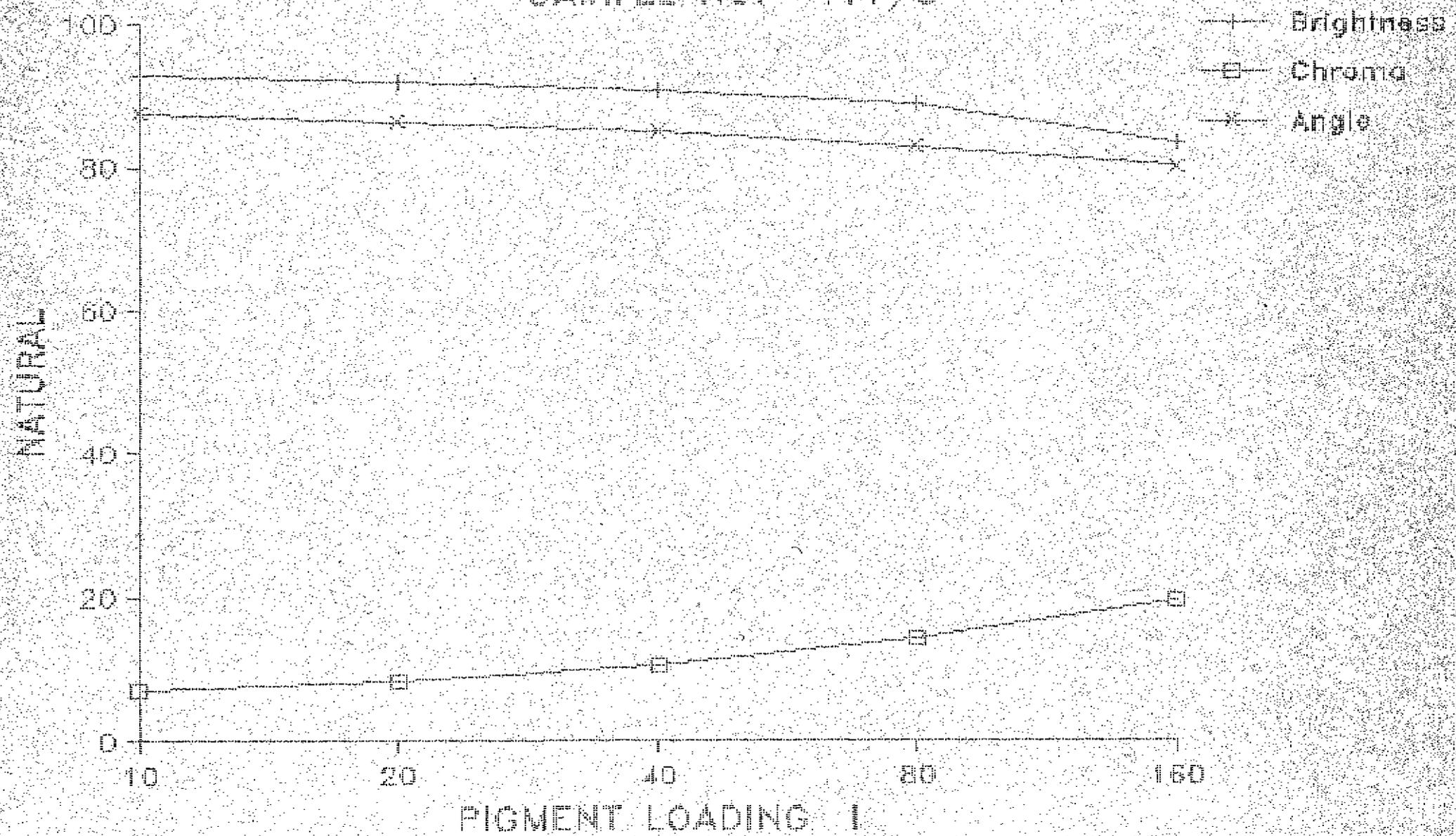
048

SAMPLE NO: TT1/5



TASMANIAN OCHRE PROJECT

SAMPLE NO:— TT1/8

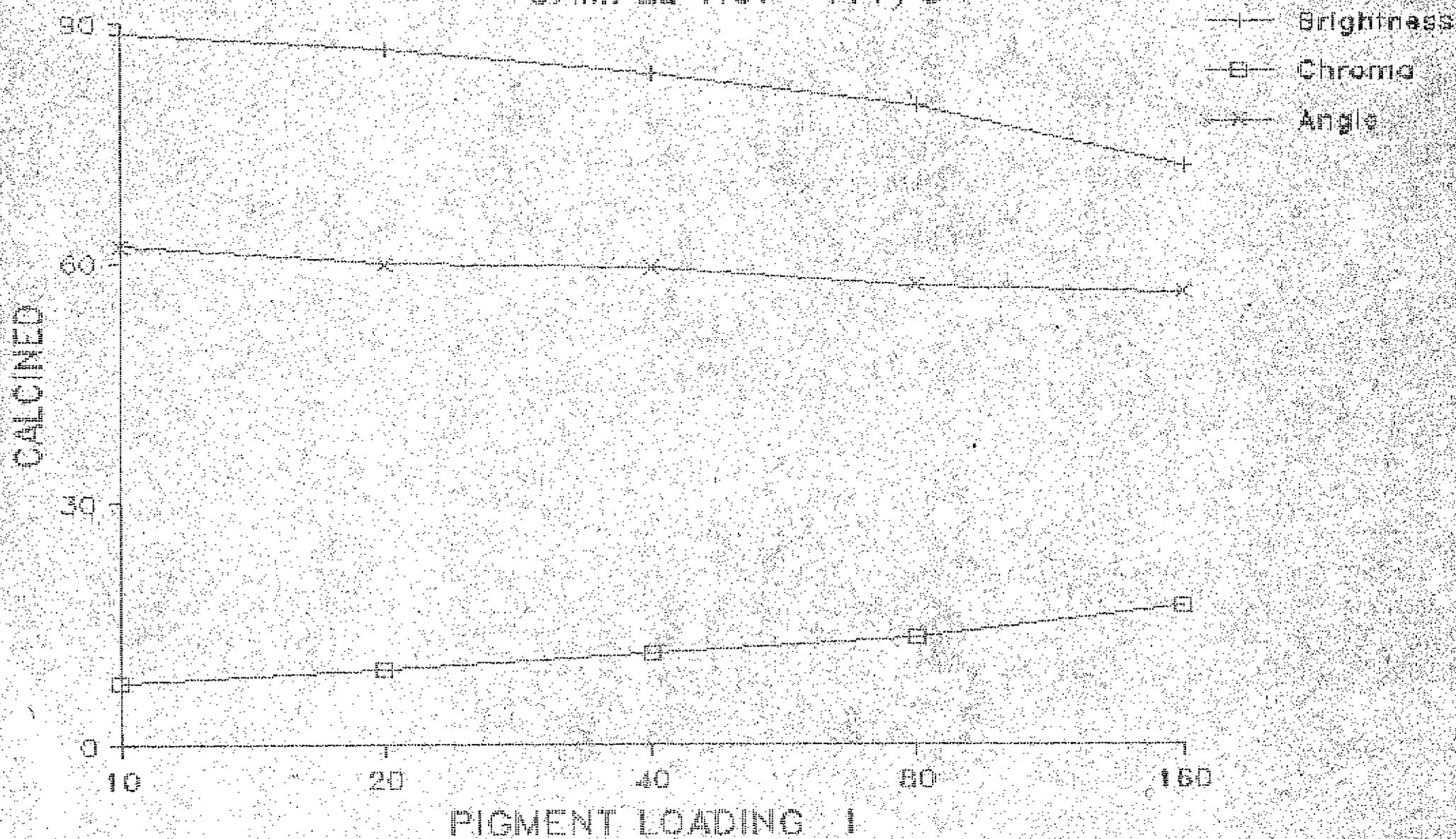


107054

052

TASMANIAN OCHRE PROJECT

SAMPLE NO:- TT1/8



107056

054

TASMANIAN OCHRE PROJECT

SAMPLE NO: - TT4/6

MILLED:-
CALCINED:8 HRS
340 CTOTAL PIGMENT LOADING
323 g/l

MINUS 100µm FRACTION

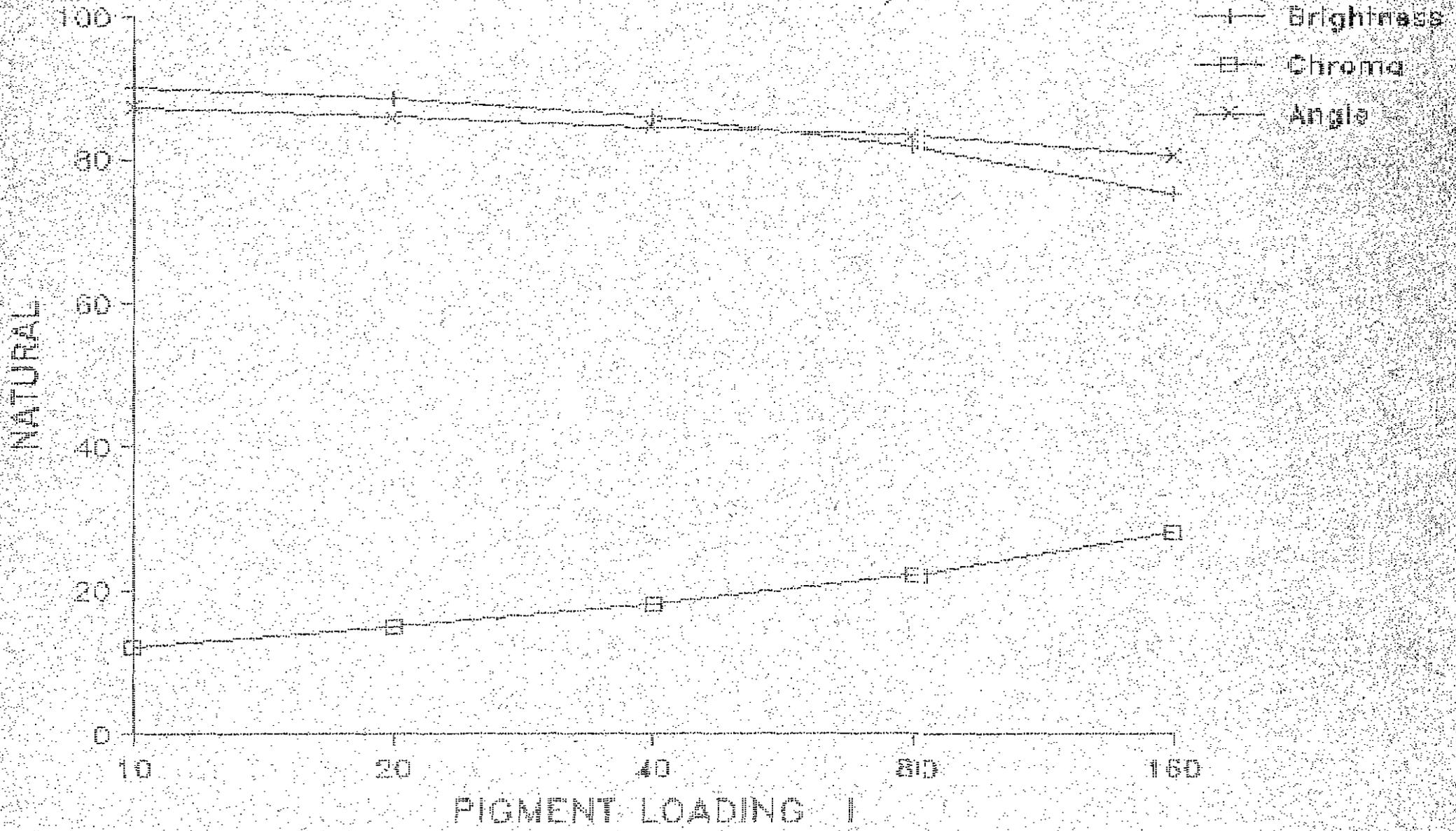
SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightnes	1	90.1	1	88.4	1	85.8	1	81.7	1	75	1
Chroma	1	11.9	1	14.8	1	18	1	22	1	28.2	1
Angle	1	87.2	1	85.7	1	84.4	1	83.2	1	80.5	1
PIGMENT LOADING grams/litre	1		1		1		1		1		1
	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightnes	1	82.2	1	78.7	1	74.2	1	67.8	1	58.3	1
Chroma	1	13.4	1	15.4	1	18.5	1	21	1	23.9	1
Angle	1	55.1	1	54.3	1	52.6	1	52.4	1	50.6	1

107057

TASMANIAN OCHRE PROJECT

SAMPLE NO: TT4/6

30
CI

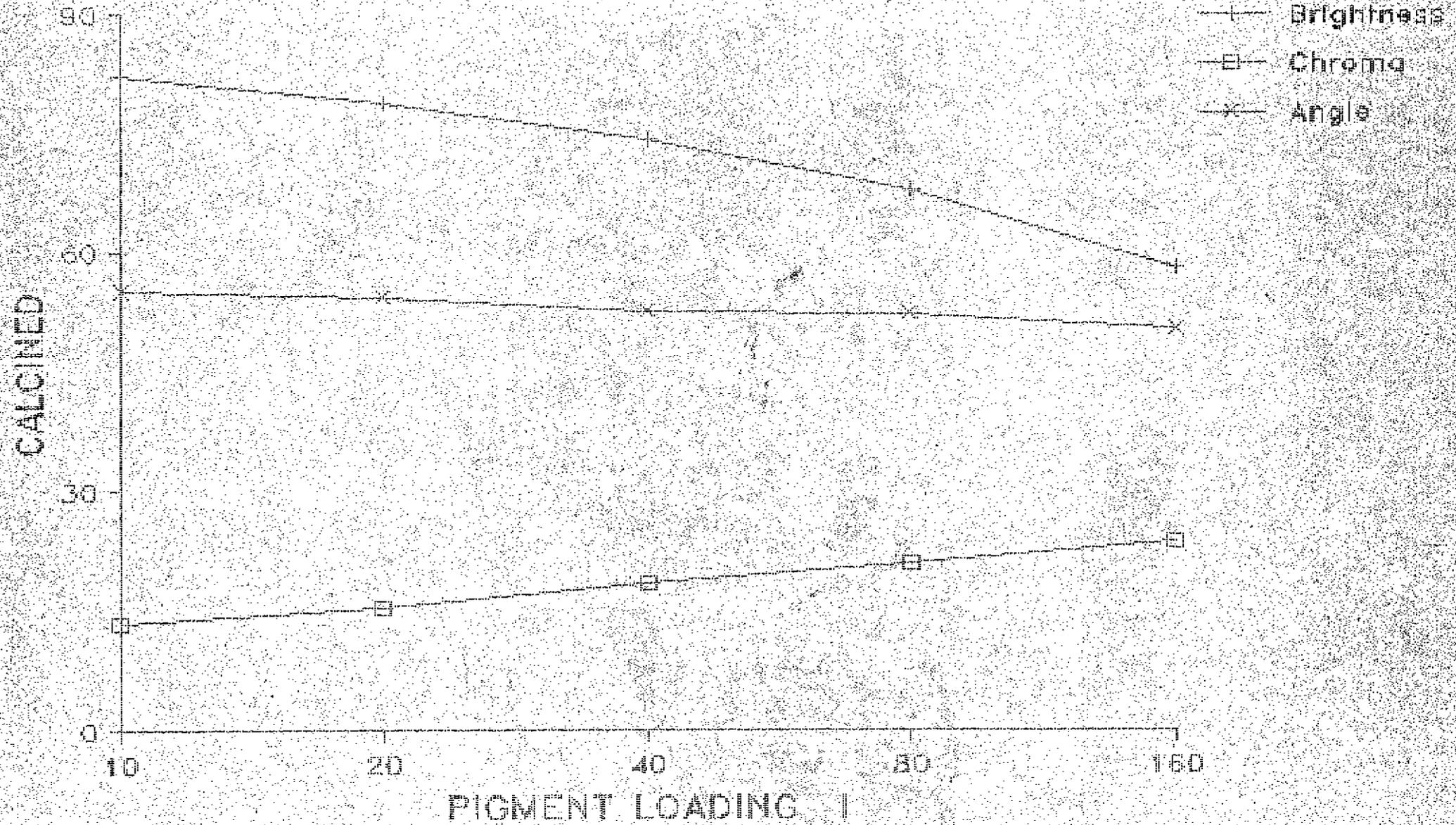


107058

TASMANIAN OCHRE PROJECT

SAMPLE NO: - TT4/6

050



107060

058

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT3/6

MILLED:-
CALCINED:8 HRS
300 CTOTAL PIGMENT LOADING
323 g/l

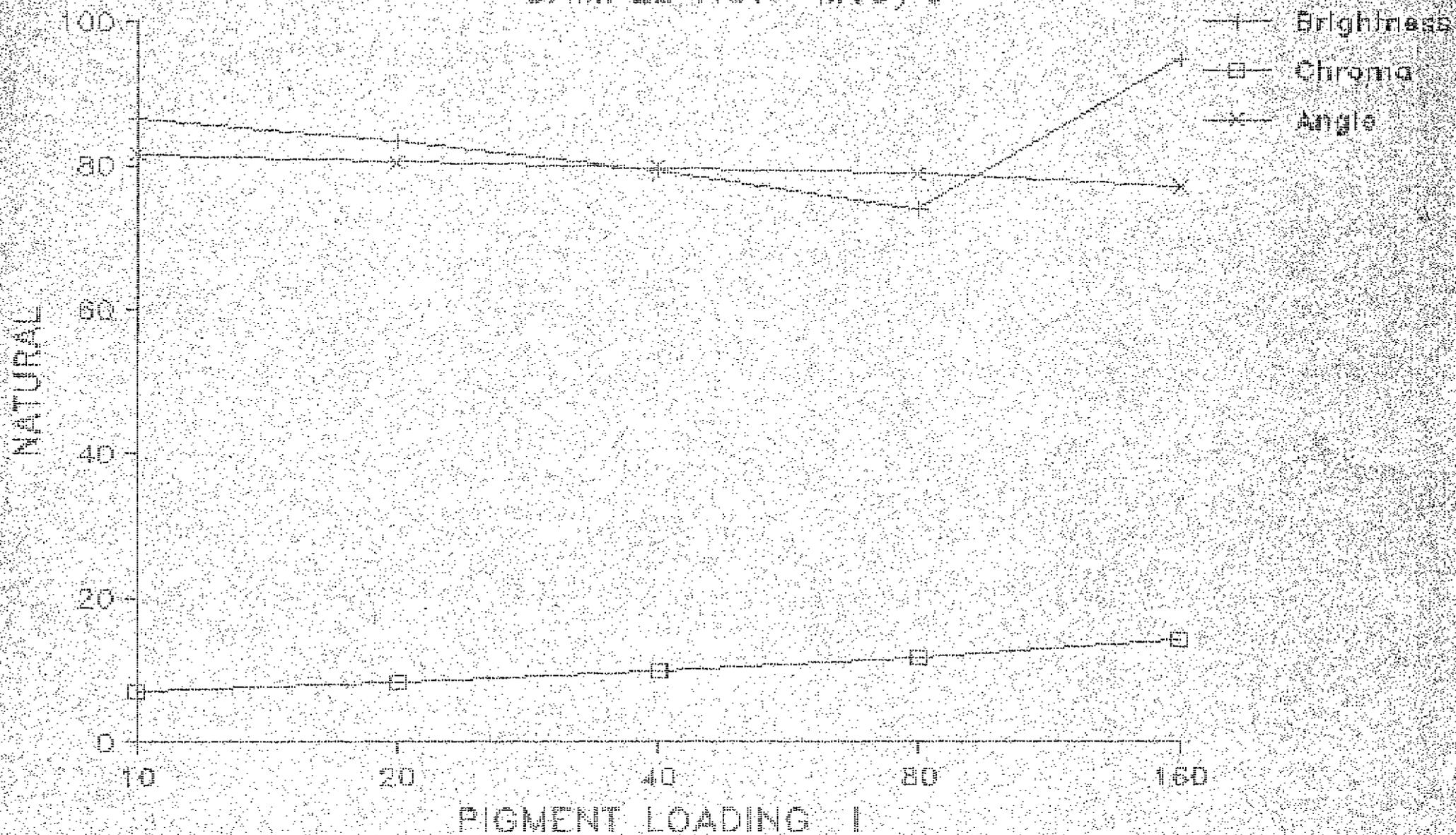
MINUS 100µm FRACTION

SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	86.4	1	83.4	1	79.3	1	73.8	1	94.8	1
Chroma	1	7	1	8.2	1	9.7	1	11.7	1	14.1	1
Angle	1	81.5	1	80.4	1	79.6	1	78.8	1	77	1
PIGMENT LOADING grams/litre	1		1		1		1		1		1
	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	82.4	1	79	1	73.8	1	67.6	1	57.7	1
Chroma	1	6.8	1	7.7	1	9	1	10.6	1	12.6	1
Angle	1	55.1	1	54.4	1	53.8	1	53.9	1	53.8	1

107061

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT3/6

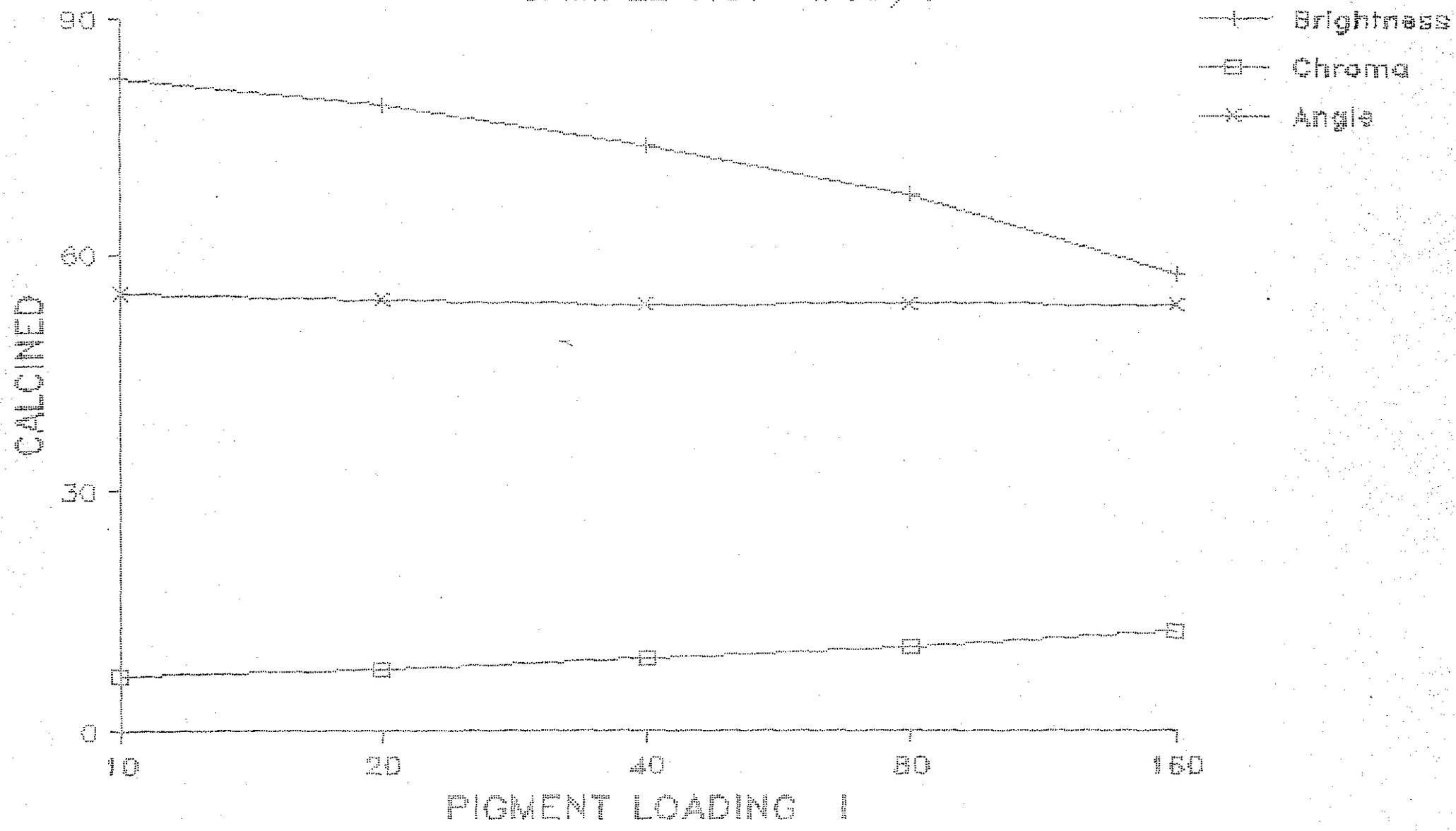


107062

090

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT3/6



107064

062

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT5/4

MILLED:-
CALCINED:-8 HRS
300 CTOTAL PIGMENT LOADING
323 g/l

MINUS 100um FRACTION

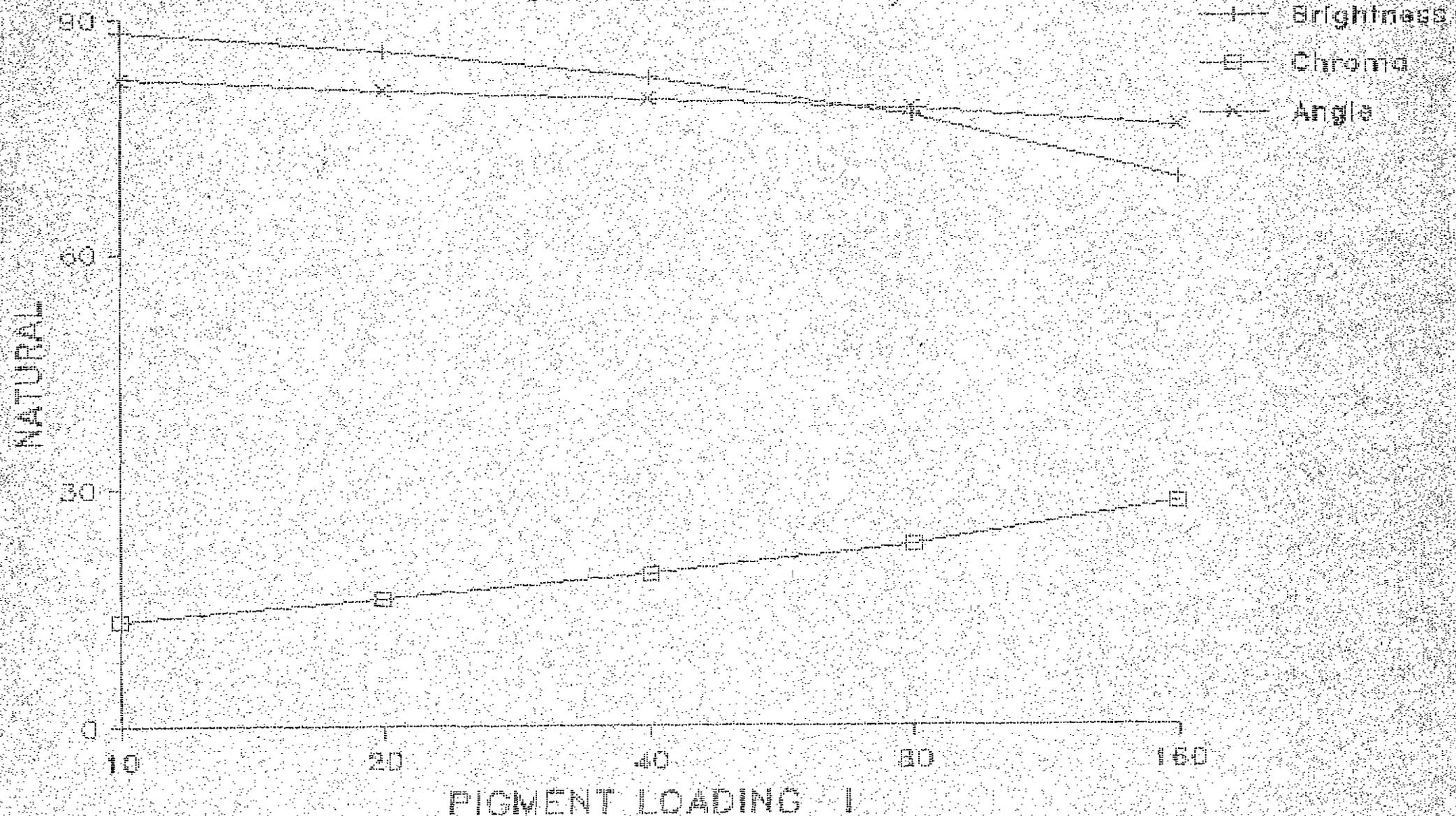
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	
NATURAL	1	1	1	1	1	1	1	1	1	
Brightness	1	88.2	1	85.8	1	82.3	1	77.6	1	69.6
Chroma	1	13.4	1	16.2	1	19.3	1	23.1	1	28.5
Angle	1	82.3	1	80.8	1	79.6	1	78.5	1	76.2
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	78.7	1	74.6	1	69.6	1	63.1	1	53.6
Chroma	1	13.2	1	15.3	1	17.4	1	19.7	1	22.1
Angle	1	48.1	1	47.9	1	46.7	1	46.5	1	45.4

107065

063

TASMANIAN OCHRE PROJECT

SAMPLE NO:- MT5/4

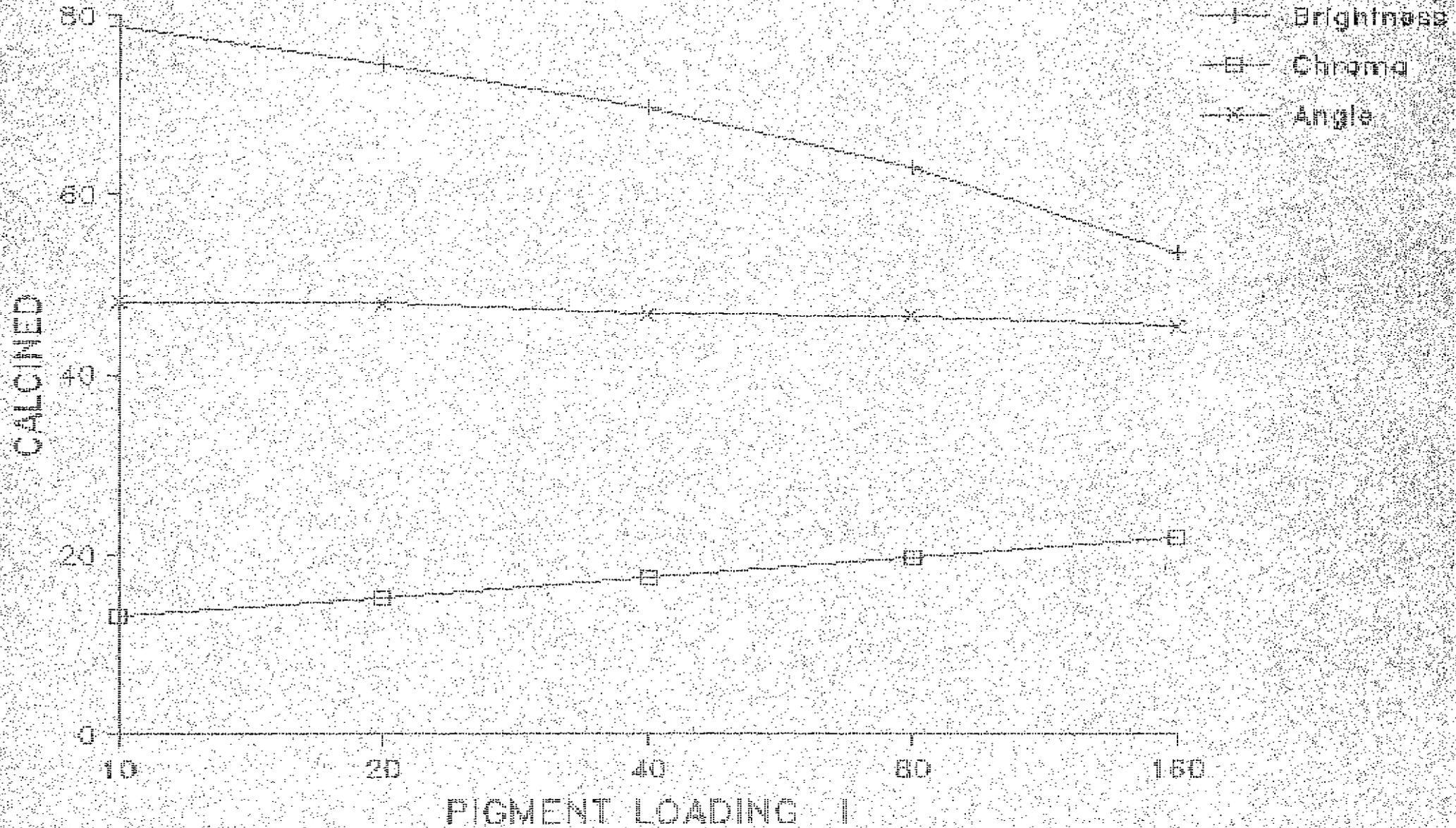


107066

054

TASMANIAN OCHRE PROJECT

SAMPLE NO: - MT5/4



065

107067

APPENDIX IV
DATA FOR OXYGEN FREE CALCINATION

SAMPLES H5/1R and MT1/1R

Colour charts

Digitised data

Graphs

107068



TASMANIAN OCHRE PROJECT

SAMPLE NO :- HT 5/1

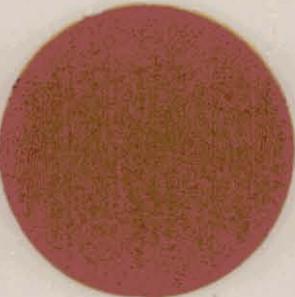
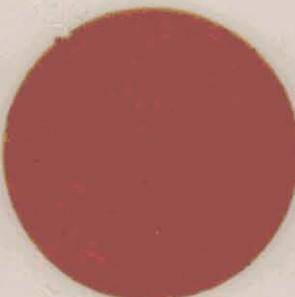
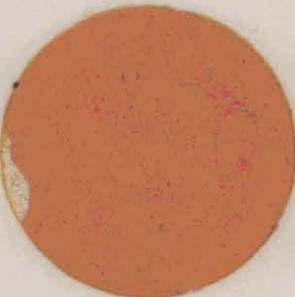
MILLED:- 8 HRS
CALCINED: 300 R C

TOTAL PIGMENT 323 g/litre

050

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1	1
PIGMENT LOADING grams/litre	1	1	1	1	1	1	1	1	1
	10	20	40	80	160				
CALCINED	1	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1	1



107069

290

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1R
MINUS 100um FRACTION

MILLED:- 8 HRS
CALCINED: 300 C
REDUCTION

TOTAL PIGMENT LOADING
323 g/l

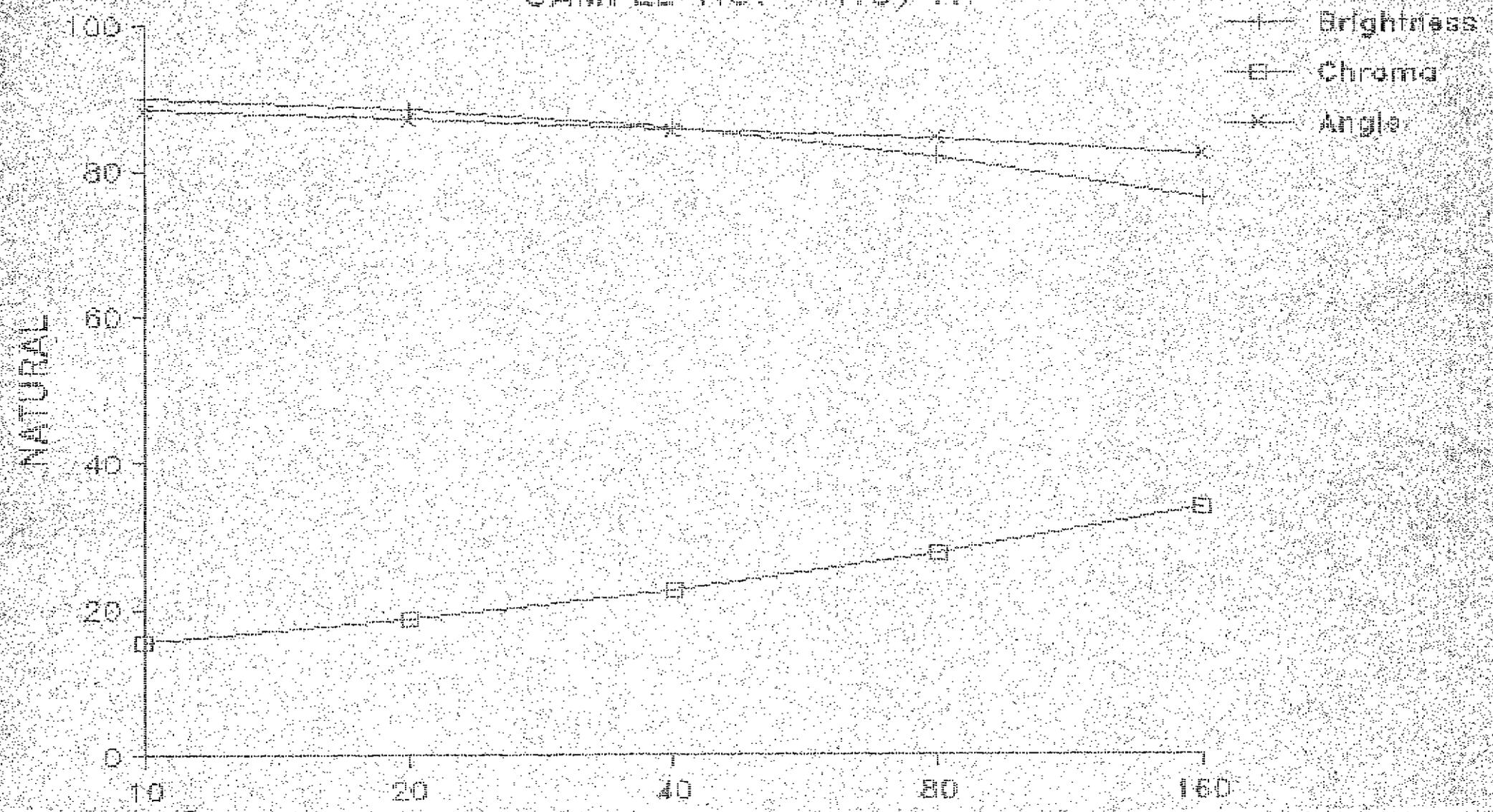
SAMPLE TYPE	1	1	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1	1	1
Brightness	1	90.1	1	89.3	1	85.7	1	81.9	1	76
Chroma	1	15.5	1	18.6	1	22.5	1	27.4	1	33.9
Angle	1	88.3	1	87	1	85.5	1	84.3	1	82.2
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160
CALCINED	1	1	1	1	1	1	1	1	1	1
Brightness	1	78.6	1	71.5	1	70.7	1	64.5	1	55.9
Chroma	1	18.7	1	21	1	23.5	1	26.3	1	29.3
Angle	1	52.7	1	51.7	1	51.2	1	50.3	1	49

107070

030

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1R

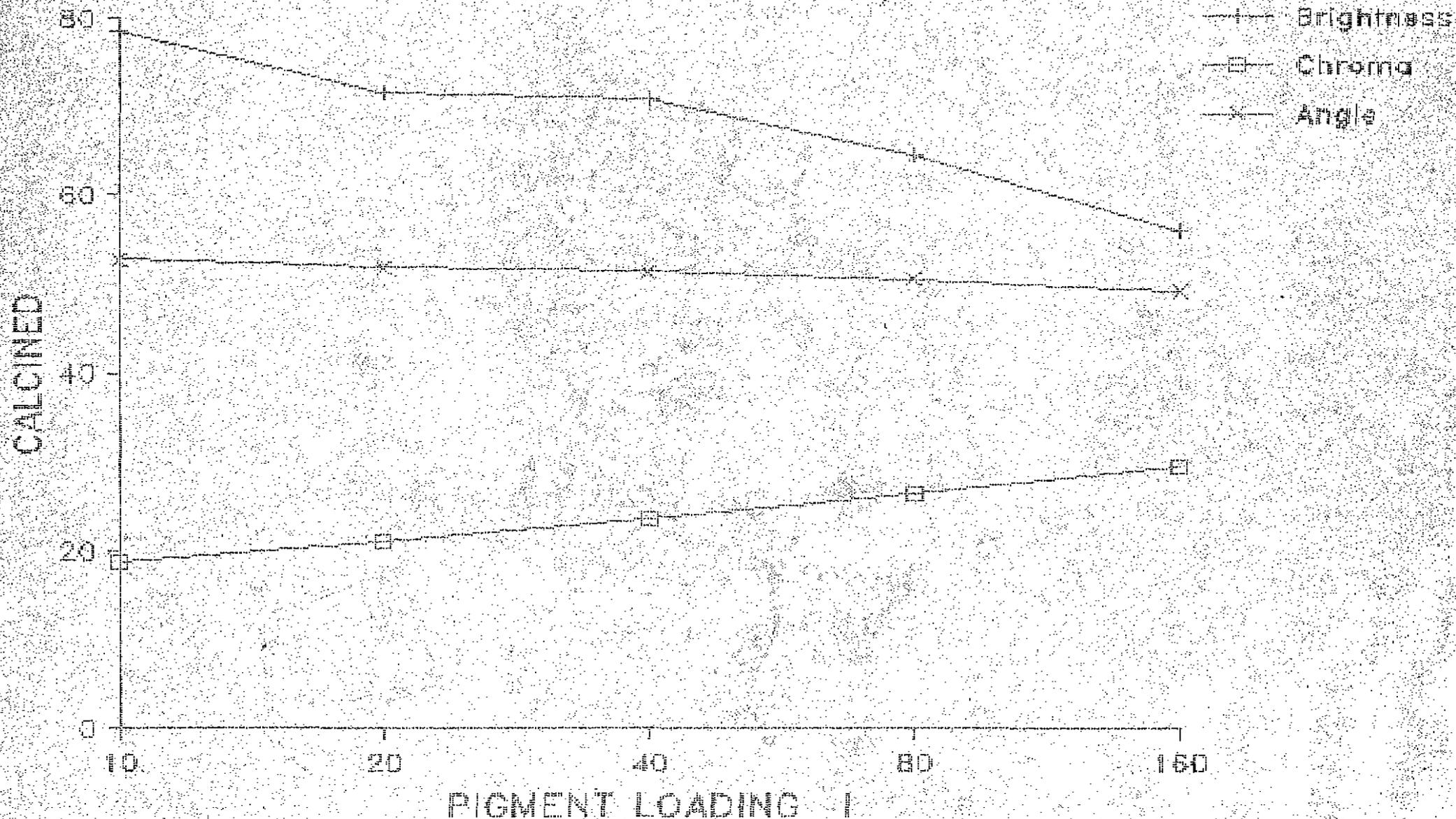


107071

TASMANIAN OCHRE PROJECT

SAMPLE NO:- HT5/1R

690



107072

070

TASMANIAN OCHRE PROJECT

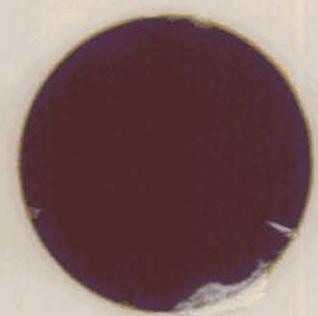
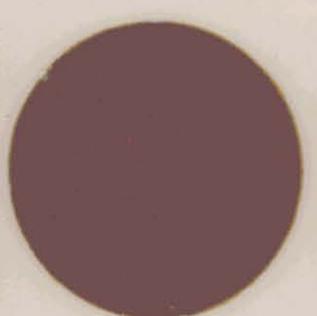
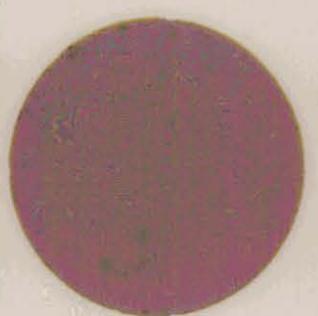
SAMPLE NO :- NT 1/1

MILLED:- 8 HRS
CALCINED: 300R C

TOTAL PIGMENT 323 g/litre

MINUS 100um FRACTION

SAMPLE TYPE	1	1	1	1	1	1	1	1
NATURAL	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1
PIGMENT LOADING grams/litre	1	1	1	1	1	1	1	1
	10	20	40	80	160			
CALCINED	1	1	1	1	1	1	1	1
Brightness	1	1	1	1	1	1	1	1
Chroma	1	1	1	1	1	1	1	1
Angle	1	1	1	1	1	1	1	1



107073

TASMANIAN OCHRE PROJECT

SAMPLE NO: - MT111R

MILLED: -

8 HRS

TOTAL PIGMENT LOADING

CALCINED:

300 C

323 g/l

MINUS 100um FRACTION

REDUCTION

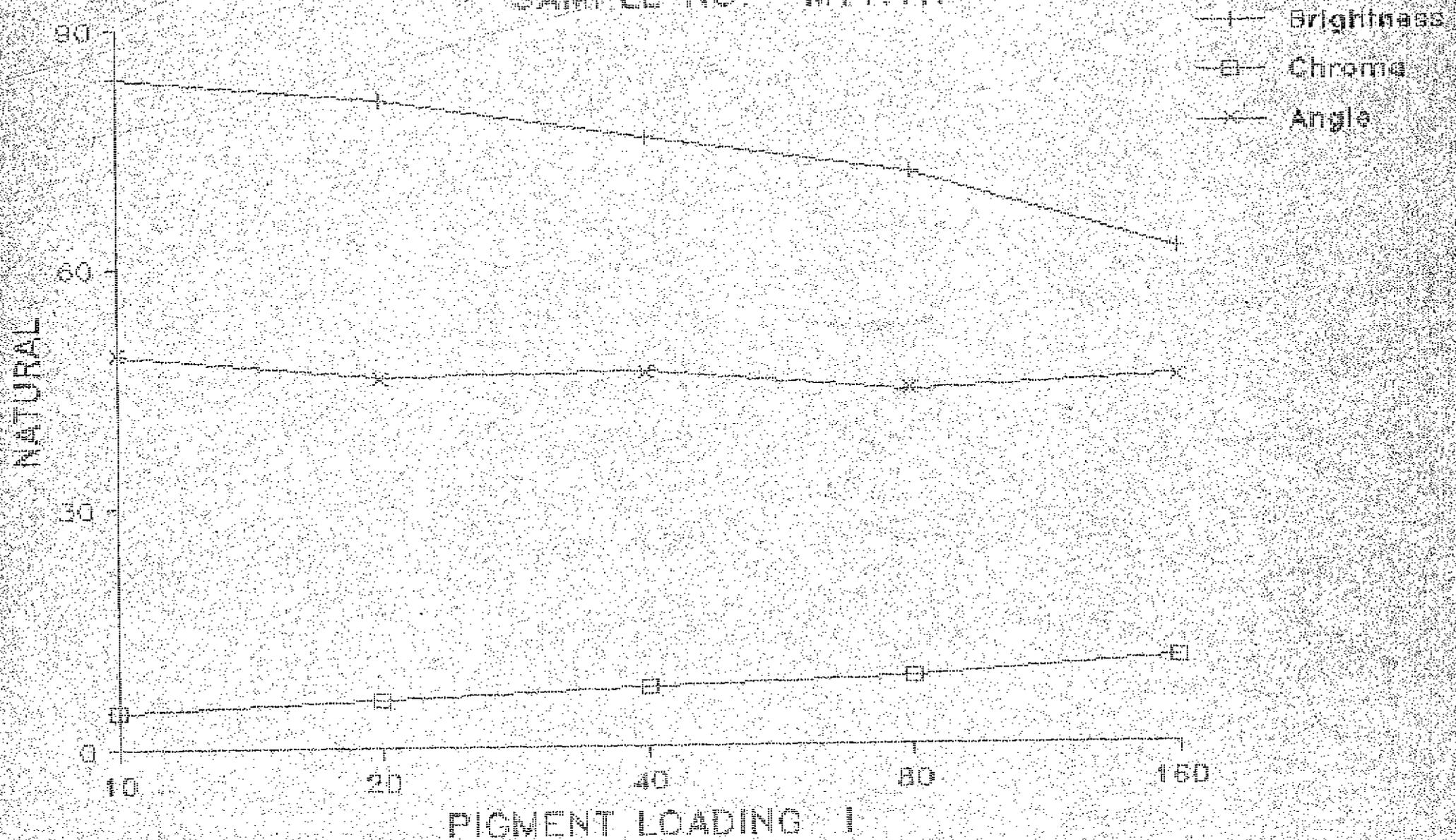
SAMPLE TYPE	1		1		1		1		1		1
NATURAL	1		1		1		1		1		1
Brightness	1	83.9	1	80.9	1	76.1	1	71.5	1	62	1
Chroma	1	4.6	1	6	1	7.3	1	8.5	1	10.9	1
Angle	1	49.2	1	45.2	1	46.8	1	44.4	1	46	1
PIGMENT LOADING grams/litre	1	10	1	20	1	40	1	80	1	160	1
CALCINED	1		1		1		1		1		1
Brightness	1	81.6	1	77.5	1	72.9	1	66.1	1	55.9	1
Chroma	1	6.8	1	8	1	9.1	1	10.5	1	12.5	1
Angle	1	44.4	1	43.8	1	44.1	1	43.5	1	43.9	1

107074

2/2

TASMANIAN OCHRE PROJECT

SAMPLE NO: MT111R



107075

0.01

TASMANIAN OCHRE PROJECT

SAMPLE NO:- NT111R

