



TASMANIA

SEMESTER REPORT ON EXPLORATION LICENCE
WESTERN JUNCTION EL 4/76 GRANTED ON
8TH MARCH, 1976, RENEWED ON 27TH
OCTOBER, 1976 AND EXPIRING ON
5TH MARCH, 1977.

CONFIDENTIAL

81-1633

TASMANIA DEPARTMENT OF MINES

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Semester Report on Exploration Licence Western Junction EL4/76 granted on 8th March, 1976, renewed on 27th October, 1976 and expiring on 5th March, 1977.

Condition of licence: to explore for non-metallic minerals (in this case kaolin).

Location: immediately east of Launceston airport, at Breadalbane.

For schedule, maps used, methods of mapping etc. see previous report (17.9.1976).

Fieldwork:

A field assistant was employed in the period 17th November to 25th November, 1976. Fifty auger holes were sunk in the exploration area, up to 4.5m deep. The area in which consistently lime free greywhite and blue-grey ball clay was encountered is outlined in figure 1. The outcrop of ball clay in the northern, eastern and southern part of the lease is inconsistent.

Size of the deposit:

Of the 3 km² previously indicated as promising only 1 km² remains of interest. Assuming 10% of all sediments up to a depth of 20 m to be rather pure kaolinitic clay the reserve would be 2 x 10⁶ m³. The depth of the deposit is based on relief in the area and the Maunsell drill holes referred to in the previous semester report.

The Western Junction ball clay as pottery clay

Further ceramic tests by Mr. P.J. Davies (potter) have been reported in the monthly reports. I have reported earlier, that we had difficulty in removing the goethite from the raw clay. Sieving at 120 or 200 mesh followed by ball milling for one hour gives good results. Very little material is coarser than the sieve mesh and sieving may be eliminated as ball milling is done anyhow in mixing ceramic materials.

The results obtained are pleasing and quite satisfactory for small items. Manufacture of heavy duty ware with 50% ball clay and manufacture of high quality stoneware with 40% or less ball clay mixed with the usual additives - china clay, potash feldspar and silicon - is within reach.

There may be some reluctance among the potters to go through the costly process of opening up a new clay pit.

Use as Refractory Clay

A refractory nature of the Western Junction ball clay is anticipated

because of its essentially kaolinitic composition and chemical constitution. A clay of Powranna, 15 km to the south, has been used consistently in the past as a fire brick for boilers and furnaces. Australian Industrial Refractories at Newcastle analysed the Western Junction clay and found it similar to their Goulburn clay. I tested a sample of the Western Junction at 1400° and did not appreciate softening. The test, however, is incomplete as I have no access to a high temperature furnace (1600°C) and the facilities to perform the essential "Reheat Test" British Standard 1902, Part 1A, 1966 or A.S.T.M. Designation C113-61.

It is, however, possible to predict the behaviour of the clay at high temperature with some accuracy applying the method of Ludwig, who compiled a chart on the assumption that clays when fired, form solid solutions of the minerals constituting the impurities in the clay and that they must, therefore, reduce the melting point of the clay according to their molecular concentration. He determined the refractories of many clays of different compositions and then calculated their formulae, assuming the alumina to be unity i.e. $(R_2O + RO) : Al_2O_3 : SiO_2 = Y : 1 : X$. Iron oxide should be calculated as FeO. He then marked off the refractories of the clays on a graph. When the iso-refractory lines corresponding to the various Seger cones are plotted on the graph, they enable the refractories of any material of a composition lying on or between any of these lines to be ascertained with a fair degree of accuracy. The chart is useful for clays containing up to six per cent of bases, but for less pure clays it is useless. The position of the Western Junction and Pioneer clay are plotted in figure 2 and the temperature key is given in table I.

American ball clays are extensively used as fire clays, (Lefond 1975), English to a lesser extent, (Ennos and Scott, 1924, Cardew 1969), particularly because of their higher potash content.

As a point of historical interest it should be mentioned that clay overlying a coal seam at Dulverton (near Railton) was used for fire bricks in the smelters at Mt. Lyell and Salisbury's foundry in Launceston. The idea that fire clays must be seat earths of growing vegetation has conclusively been refuted by White (1970) (cf. Grimsahw, 1971).

Upgrading with aluminium oxide from Comalco, precalcined at 1100°C, is under investigation. It may be possible to produce high aluminous and high alumina refractories from kaolin - Al_2O_3 mixtures.

Use as Papercoating Clay

Paper filler clays are readily available in Australia and produced at Ballarat and Tonganah.

All coating clay used in Tasmania is imported from the U.S.A. where particularly suitable ball clays are degrittled, classified, subjected to ultraflotation and bleached with zinc dithionite. The colour requirements are stringent: to be acceptable in paper making clays should have reflectance values ("brightness") in excess of 88% over the range 4000 - 6000 Å, indicating that they are both bright and white. This brightness can usually be achieved through ultraflotation and bleaching (Murray, 1976).

The physical properties necessary for coating clay are a minimum Brookfield viscosity for clay particles $<2\mu$ of 25°C, 70% solids, No. 1 spindle, 20 RPM in the order of 100 - 200. (Suggested method T6485m - 54, Technical Association Pulp and Paper Industry, New York.) In practice this means that previously strongly sheared clay suspension at 70% solids can be stirred with a spatula if it were medium duty motor oil. This stringent requirement can probably not be met, although a final test has to be performed.

Chemical Analysis

New chemical analyses are compiled in table II (see also table III - previous semester report). A table of the industrial classification of the Tasmanian clays is given in table III (see program report).

Table IV gives the chemical composition of some well known examples for these industrial clays, derived from the literature. A selection of the analyses is compiled in table V.

I do not entirely agree with W.F. Ward, Government Analyst at the turn of the century, who would not analyse clays for W.H. Twelvetrees, the Government Geologist: "These analyses would be long and tedious and would serve no useful purpose, as compared with practical tests by a potter under ordinary working conditions".

From table IV can be concluded how surprisingly close the South Mount Cameron clay is to pure kaolin. Also the pure kaolin from Tonganah (previous report). Pioneer and Western Junction are in many aspects similar. the latter deposit being more rich in iron, the former being more potash rich and slightly siliceous. Admittedly the major differences between the deposits are rather a question of grain size, Pioneer being much coarser. Compare also the rather comparable ball clays from England, listed in table III. The English material is much more potash rich.

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St. Helens is still in the range of the ball clays, but is getting too gritty, as expressed in the higher SiO_2 and lower Al_2O_3 values. Note also the much higher K_2O content, indicating a chemically less weathered nature. Pipe Clay Lagoon, one of the newly analysed materials, is virtually similar to St. Helens ("pipe clay" is the coarse variant of ball clay, suitable for pipemaking).

The other analyses on table III are further arranged according to increasing SiO_2 content, decreasing Al_2O_3 , which corresponds to increasing K_2O content. The trend corresponds probably to more quartz and illite and less kaolin in the clay. The origin of so much K_2O in some very siliceous southern clays (Forcett 44508 at 4.2% K_2O) is difficult to explain. Some of the more iron rich kaolinitic clays (Forcett, Kingston) have been used in brick manufacture, after degrading with very iron rich clay of a composition like Hayes Prison Farm (44539). The computation of the refractoriness from the chemical analyses has been outlined above.

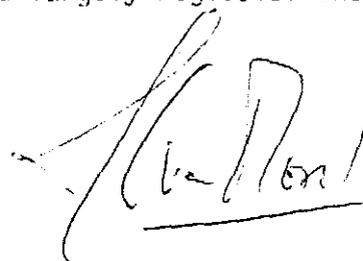
Future Work

The most urgent task is to verify the suitability of paper coating qualities of the Western Junction clay, which I find hard to do because of the obscure nature of the TAPPI instructions.

Secondly the refractory nature of the Western Junction clay has to be tested, and mixtures made with Comalco Al_2O_3 to increase the refractoriness.

Thirdly the chemical classification of the Western Junction clay has to be completed.

Black English ball clays are more suitable for ceramic work than white ones: they are finer and the carbon burns out (Scott, 1929). This has to be tested on fresh field samples, as I have largely neglected the more black ball clays.



J.C. van Moort

Geochemist

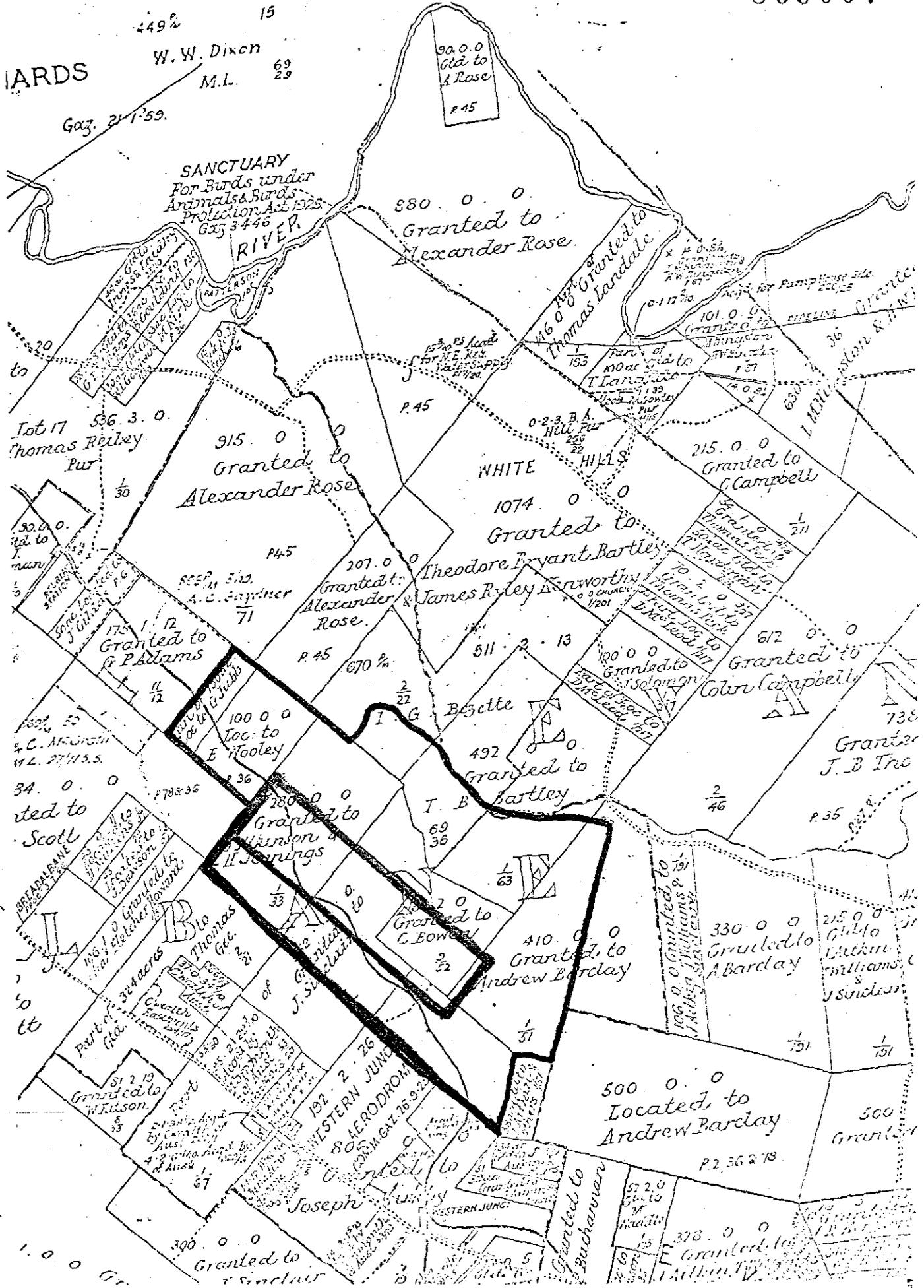
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- F.R. Ennos and A. Scott (1924) Refractory Materials: Fire Clays. Spec. Rep. Min. Res. Great Britain, Volume XXVIII. H.M. State Office, London.
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Figure 1: Western Junction kaolin deposit. The licence area is outlined in black. The area with consistent ball-clay outcrop is outlined in red.

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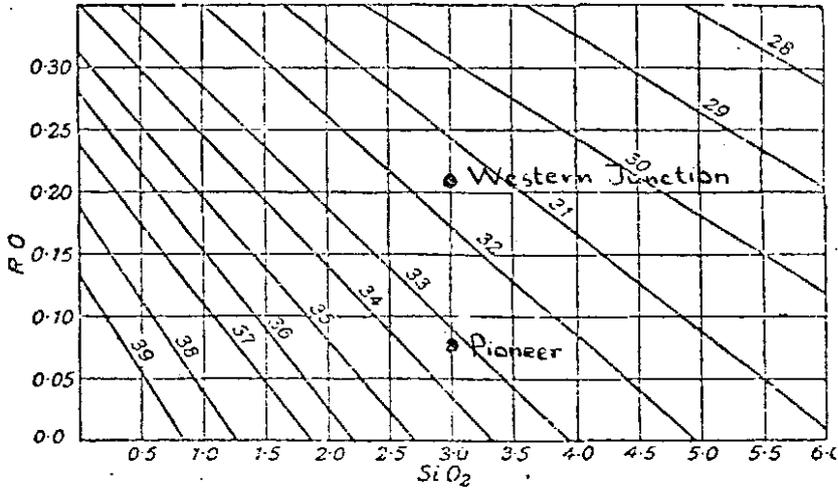


Figure 2: Ludwig chart for plot of refractories. For the temperature equivalent of the Seger cones see Table I.

Attempt 1 = A

40% K37 china clay
 40% Western Junction ball clay <120 mesh
 10% silica 72 mesh
 10% potash feldspar

Remark: But for small iron stains, spoiling the appearance, a good product. Fired at 1300°C. No further measurements have been made.

Attempt 2 = B

50% K37 china clay
 50% Western Junction ball clay <120 mesh
 10% silica 72 mesh
 10% potash feldspar
 handles: good

dry shrinkage 6-6½%
 firing shrinkage 1300°C 14.5%
 throwing quality good
 plasticity good
 handles: good

Remark: not completely homogenised by blunging.

Attempt 3 = C

20% Tonganah china clay
 60% Western Junction ball clay
 10% silica 72 mesh
 10% potash feldspar

dry shrinkage 7 - 7½%
 firing shrinkage 1300°C 14.5%
 throwing quality good
 plasticity good
 handles: good

Remark: this batch was ball-milled for 2 hours. Material completely homogenised.

Attempt 4 = D

30% South Mt. Cameron china clay <120 mesh
 50% Western Junction ball clay (<200 mesh wet sieved, ball milled for 1 hour)
 5% silica <100 mesh
 15% potash feldspar <200 mesh

dry shrinkage 7 - 7½%
 firing shrinkage 1300°C 14.0 to 14.5%

Remark: because of the shorter ball milling time, the aspect of the clay is livelier than in attempt 3=C. good end product. Shrinkage too high.

Attempt 5 = E

20% South Mt. Cameron china clay <200 mesh
 50% Western Junction ball clay (<350 mesh wet sieved, ball milled for 1 hour)
 15% silica <200 mesh
 15% potash feldspar <200 mesh

Dry shrinkage 7-7½%
 firing shrinkage 14.5-15.0%

Remark: the appearance is similar to attempt 4 = D. good end product, shrinkage too high.

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TABLE I

CHARACTERISTICS OF SEGER CONES

Cone No.	Equivalent Temp. °C	Cone No.	Equivalent Temp. °C	Cone No.	Equivalent Temp. °C
022	600	1a	1100	26	1580
021	650	2a	1120	27	1610
020	670	3a	1140	28	1630
019	690	4a	1160	29	1650
018	710	5a	1180	30	1670
017	730	6a	1200	31	1690
016	750	7	1230	32	1710
015	790	8	1250	33	1730
014	815	9	1280	34	1750
013	835	10	1300	35	1770
012	855	11	1320	36	1790
011	880	12	1350	37	1825
010	900	13	1380	38	1850
09	920	14	1410	39	1880
08	940	15	1435	40	1920
07	960	16	1460	41	1960
06	980	17	1480	42	2000
05	1000	18	1500		
04	1020	19	1520		
03	1040	20	1530		
02	1060	21	Not manu-		
01	1080	25	factured		

STONEWARE CLAY SAMPLES - GWYN HANSEN

44539 = Hayes Farm Clay (earthenware clay)

44540 = Ouse Clay

44541 = Forcett Clay

44542 = St. Helens Beach Clay

44543 = Coles Bay

44544 = Pioneer Clay

44545 = Egg and Bacon Bay Clay

44546 = Kalle Anke, T.C.A.E.

44547 = Quarry Hill, Campbell Town

44548 = Merton Vale, Campbell Town

44549 = Kingston Pit - L.H. side

44550 = St. Helens

44551 = Oyster Cove

44552 = Manuka Road Clay

44553 = Hamilton Clay (Cleveland)

<p>China clay</p>	<p>(1) Kaolinised Devonian granite in N.E. area, Tonganah, South Mt. Cameron, Pioneer.</p> <p>(11) Weathered Cretaceous syenite in Surges Bay and Cygnet area.</p>
<p>Ball Clay</p>	<p>(1) Tertiary river and lake deposits in Launceston Basin (Western Junction)</p> <p>(11) Tertiary river and lake deposits near St. Helens.</p> <p>(111) Tertiary drifts overlying tin gravels in N.E.</p>
<p>Fireclay</p>	<p>(1) Precambrian clayey siltstone in Mawbanna area, N.W. Tasmania.</p> <p>(11) Tertiary drifts overlying tin gravels in N.E.</p> <p>(111) Tertiary kaolin at Forcett and Powranna.</p> <p>(IV) Associated with coal measures (Dulverton, Sandfly)</p>
<p>Brick clay</p>	<p>(1) <u>Tertiary</u> brick and pipe manufacture from Tamar sedimentary basin sandy clay, and pipe manufacture from plastic clay in Derwent Valley (e.g. Hamilton-Ouse).</p> <p>(11) <u>Triassic</u> mudstone used in southern Tasmania for brick manufacture (e.g. old Knocklofty and Giblin Street quarries, Ten Mile Hill, Austins Ferry).</p> <p>(111) <u>Permian</u> mudstone used in Launceston area for tile manufacture and has been used for bricks at Wynyard (L.Permian varved clay and Quamby mudstone) Dulverton (Quamby mudstone and fire-bricks from Mersey coal measures), Dover (Grange mudstone = Cascades Group correlate, and Woodbridge Glacial Formation = Malbina correlate).</p> <p>(IV) Older Palaeozoic and Precambrian available but not used.</p>
<p>Bentonite</p>	<p>No economic deposits but:</p> <p>(1) montmorillonite veins in Jurassic dolerite are common,</p> <p>(11) clay interlayers in Berriedale limestone,</p> <p>(111) possibly Quaternary lunettes at Swansea.</p>

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TABLE IV

Chemical Composition of some Types of Industrial Clays

	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	H ₂ O+	H ₂ O-	CO ₂	C	Total
CHINA CLAY: EEC (processed filler)	46.77	37.79	0.56		0.24	0.13	0.05	1.49	0.02			12.79				
COATING CLAYS:																
Engelhardt	45.42	38.79	0.31			0.35	0.13	0.2	1.59			13.79				
Huber	44.46	37.5	0.3						1-2			13.9				
		to	to									to				
		39.5	0.4									14.2				
BALL CLAYS:																
Stanford & Mitchell I	48	34	1.0		0.3		0.2	1.6	0.9					13.0		98.8
" " II	50	33	1.1		0.3		0.3	2.2	1.5					11.9		97.3
" " III	55	31	1.0		0.3		0.3	2.5	1.3					8.4		99.8
Pugoon NSW	58.22	27.61	0.75		0.46	0.35	0.38	0.30	0.66					11.90		
FIRE CLAYS:																
Ennos & Scott CQ	45.22	31.32	1.76		0.51	0.23	0.23	0.94	1.08	0.07	0.03	11.30	3.00	0.04	0.04	100.03
Cumberland B	57.40	26.80	2.47		0.66	0.39	0.39	1.49	0.90			8.67	1.33	1.33		100.28
blue Devon ball clay DO	48.45	31.96	1.45		0.35	0.39	0.34	2.79	0.84		0.01	10.23	3.25		0.30	100.65
black Devon ball clay DP	43.06	28.48	1.29		0.28	0.48	0.48	2.17	0.82			15.33	4.21		3.25	100.20
PORCELAIN BODY:																
Mittagong	64.0	26.75	0.85		0.36	0.70	1.4	5.4						5.7		
STONEWARE CLAY:																
Bendigo 44527	66.52	20.50	0.81		0.55	0.01	0.24	2.27	1.36	0.05	0.00	5.17	1.30	0.00	0.70	99.56
Kingson 44549	62.39	19.11	3.82		0.65	0.99	0.19	3.26	0.78	0.00	0.00	5.17	3.59			99.91
EARTHENWARE CLAY:																
Hayes Prison Farm 44539	66.88	14.63	5.28		0.85	0.22	0.39	2.18	4.28	0.03	0.04	4.28	3.82			99.28
BRICK CLAY:																
Lithgow	64.3	15.0	4.1		1.0	0.7		4.2	0.6			7.6	2.0			99.8
boehmite Al ₂ O ₃ .H ₂ O		85.0										15.0				
gibbsite Al ₂ O ₃ .3H ₂ O		65.0										35.0				100.0
mullite 3Al ₂ O ₃ .2SiO ₂	28.0	72.0														100.0
andalousite, sillaminite and kyanite Al ₂ O ₃ .SiO ₂	36.6	62.9	1.00													100.5

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TABLE V

Chemical Composition of some Tasmanian Kaolinitic Clays of Tertiary Age

	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	FeO	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	H ₂ O+	H ₂ O-	CO ₂	C	Total
kaolinite theoretical	46.3	39.8										13.9				100.0
hypogene kaolinite Niigata	45.80	39.55	0.57	0.18	0.14	0.41	0.00	0.03	0.00	0.00	0.00	13.92	0.17			100.77
South Mt. Cameron 44520	47.50	37.26	0.80		0.00	0.00	0.00	0.45	0.72	0.03	0.00	13.27	0.75	0.00		100.78
Pioneer 44544	53.80	30.20	0.72		0.17	0.03	0.00	0.92	1.45	0.07	0.01	10.64	2.04			100.05
Western Junction grey blue fine 44529	51.55	29.40	2.04		0.66	0.27	0.35	0.49	1.13	0.01	0.00	10.17	3.83			100.37
Western Junction siliceous, sieved at 120µm 44530	51.65	29.20	2.10		0.65	0.25	0.32	0.38	1.17	0.02	0.00	10.07	3.41	0.11	0.24	99.57
St. Helens gravel pit 44532	57.99	26.66	1.45		0.29	0.02	0.11	1.54	1.78	0.12	0.00	7.29	2.08			100.82
Pipe Clay Lagoon 44517	57.01	28.12	1.56		0.70	0.13	0.23	1.16	1.09	0.02	0.01	8.66	2.84	0.00	0.26	101.84
St. Helens beach 44542	58.31	25.47	1.05		0.32	0.05	0.07	1.01	1.79	0.05	0.00	8.77	2.88			100.33
Hamilton Cleveland 44553	58.48	25.19	2.23		0.79	0.02	0.12	1.57	1.03	0.02	0.00	8.75	2.22			100.03
Kingston left 44549	62.39	19.11	3.82		0.65	0.99	0.19	3.26	0.78	0.00	0.00	5.13	3.59			99.91
Kingston 44542	62.68	21.61	2.58		0.60	0.04	0.20	3.65	1.00	0.18	0.00	8.77	2.88			99.76
Campbell Town Merton Vale 44548	71.61	15.80	1.42		0.77	0.08	0.05	2.61	0.78	0.02	0.00	4.31	2.17			99.91
Forcett 44508	74.27	14.22	1.22		0.31	0.00	0.42	4.16	0.52	0.04	0.00	3.11	0.79	0.02	0.20	98.28
Forcett 44541	72.44	13.16	2.35		0.68	0.04	1.44	2.84	0.47	0.03	0.01	3.06	2.62			99.13

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