



**ALS Metallurgy Burnie  
HiTec Minerals T1068  
Magnesite Assessment Dec 2017**



Receive and prepare three magnesite ore types:

- Fresh
- Oxidised
- New Composite

Characterisation

- Bond Ball Work Index
- Head analysis suite
- Sizing and fraction analysis

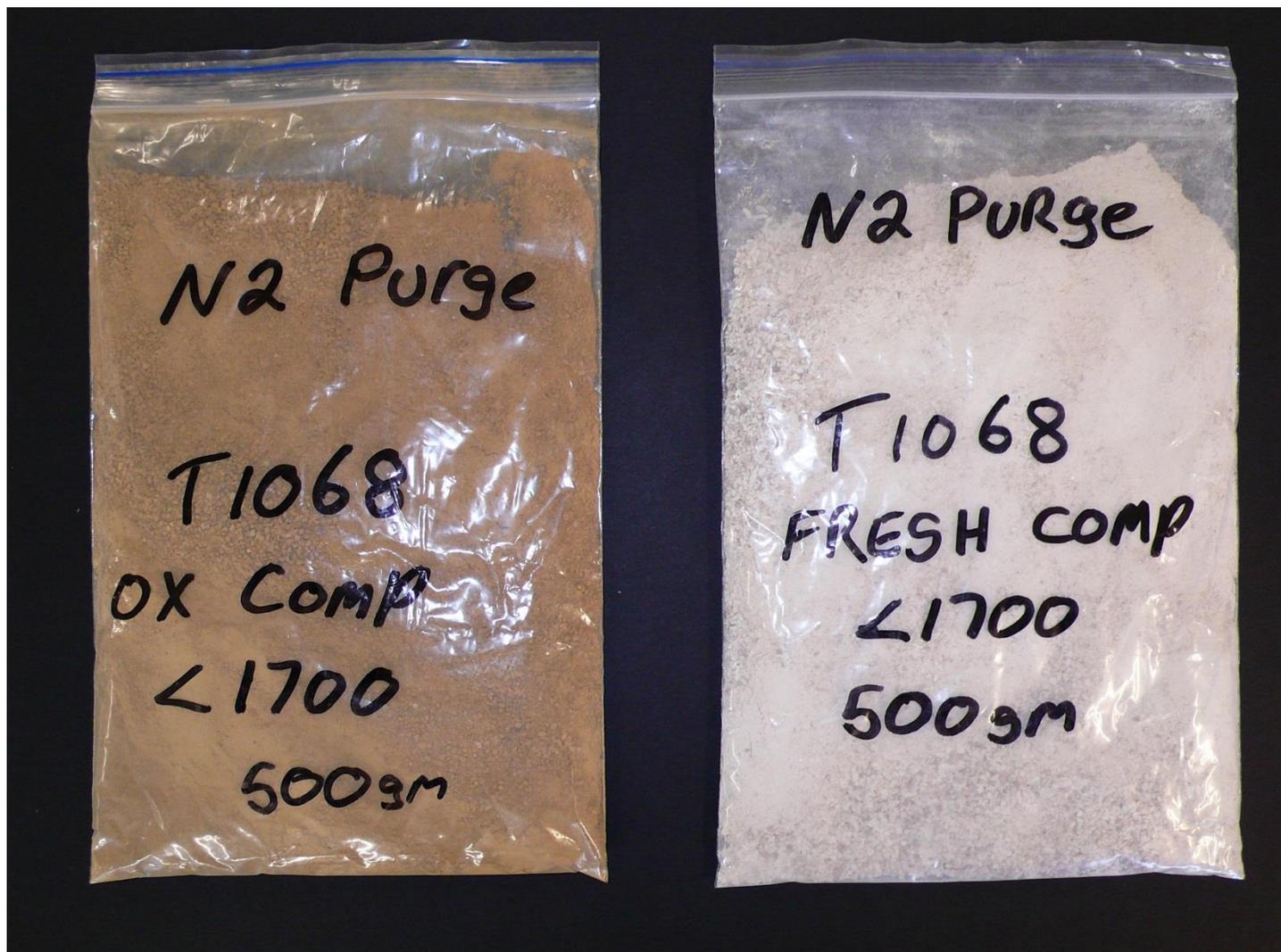
Calcination

- Calcine types at 1.70mm and 0.30mm top size, optimise

Flotation

- Define method to remove silica by flotation
- Pre and post calcination flotation

# Photos, Prepared Composites



# Head Assays



XRF26	Al2O3	BaO	CaO	Cr2O3	Fe2O3	K2O	MgO	MnO
	%	%	%	%	%	%	%	%
Fresh Composite	0.02	<0.01	2.14	<0.01	1.11	0.04	44.0	0.09
Oxide Composite	0.04	<0.01	0.83	<0.01	2.94	0.04	42.6	0.22
New Composite	0.01	0.01	0.94	0.01	0.56	0.04	46.5	0.03
XRF26	Na2O	P2O5	SO3	SiO2	SrO	TiO2	Total	LOI
	%	%	%	%	%	%	%	%
Fresh Composite	0.04	<0.01	0.12	4.15	<0.01	<0.01	100.7	48.96
Oxide Composite	0.06	<0.01	0.05	6.46	<0.01	<0.01	100.5	47.23
New Composite	0.03	0.01	0.14	1.36	<0.01	0.01	100.4	

# Bond Ball Work Index



Ore	Bond Ball Work Index (kWh/t)	Closing Screen (um)	Classification
Fresh Composite	11.7	212	Medium
Oxide Composite	7.0	212	Soft

# Sizings: Pre and Post Calcination



Product Sized		Size	Weight	
Fresh Comp <1700		um	(%)	%Pass
	p80	2360	0.00	100.0
		1700	0.00	100.0
		1180	15.33	84.7
	1103	850	20.01	64.7
		600	12.43	52.2
		425	9.12	43.1
		300	8.27	34.9
		SUB	34.85	0.0
		TOTAL	100.00	

Product Sized		Size	Weight	
Fresh Comp Calcined		um	(%)	%Pass
5354	p80	2360	0.00	100.0
		1700	0.00	100.0
		1180	8.51	91.5
	958	850	17.12	74.4
		600	13.80	60.6
		425	9.89	50.7
		300	9.04	41.6
		SUB	41.65	0.0
		TOTAL	100.00	

Sizings indicate size reduction across calcination.

# Calcination Tests



Test No	HY5354	HY5543	HY5593	HY5544	HY5594
Sample Tested	Fresh Composite	Fresh Composite	Fresh Composite	Oxide Composite	Oxide Composite
Sample Size (um)	<1.70mm	<300 µm	<300 µm	<300 µm	<300 µm
Roast Temp (deg)	800	800	850	900	850
Roast Duration (min)	60	120	120	120	120
Feed Mass (gm)	500.0	503.1	500.0	502.7	502.8
Calcine Mass (gm)	295.5	257.8	263.4	264.5	267.1
Mass Loss (%)	40.9	48.8	47.3	47.4	46.9
LOI 1000°C of Calcine (%)	10.76	1.86	1.90	0.10	0.45

Calcinations indicate moderate conversion at coarse size. Finer ground ore roasted for longer yields near complete conversion. Further optimisation is required around calcination time.

# Silica Flotation Tests: Ground Fresh Ore



Test	Product	Wt (%)	MgO (%)	Dist (%)	SiO2 (%)	Dist (%)	S (%)	Dist (%)	Fe2O3 (%)	Dist (%)	MgCO3 (%)	Dist (%)
T01	Si Conc	21.9	41.0	21.6	7.3	41.2	0.2	83.8	1.5	26.8	85.7	21.6
T02	Si Conc	38.7	40.4	37.9	7.5	67.6	0.1	89.8	1.7	51.0	84.6	37.9
T03	Si Conc	21.7	40.8	21.4	7.7	40.0	0.2	74.9	1.5	27.1	85.3	21.4
T04	Si Conc	41.2	39.9	40.0	8.2	81.8	0.1	82.3	1.7	48.2	83.4	40.0

Results indicate that a routine for silica flotation is feasible. Improvements to silica/magnesite selectivity are needed. Testing of calcine rather than ground ore may also improve results. The following reagents were used in flotation:

HCl pH adjustment	Armac C amine collector	Na2PO3 dispersant	CuSO4 activator	MIBC frother
1145 gpt	50 gpt	150 gpt	80 gpt	80 gpt

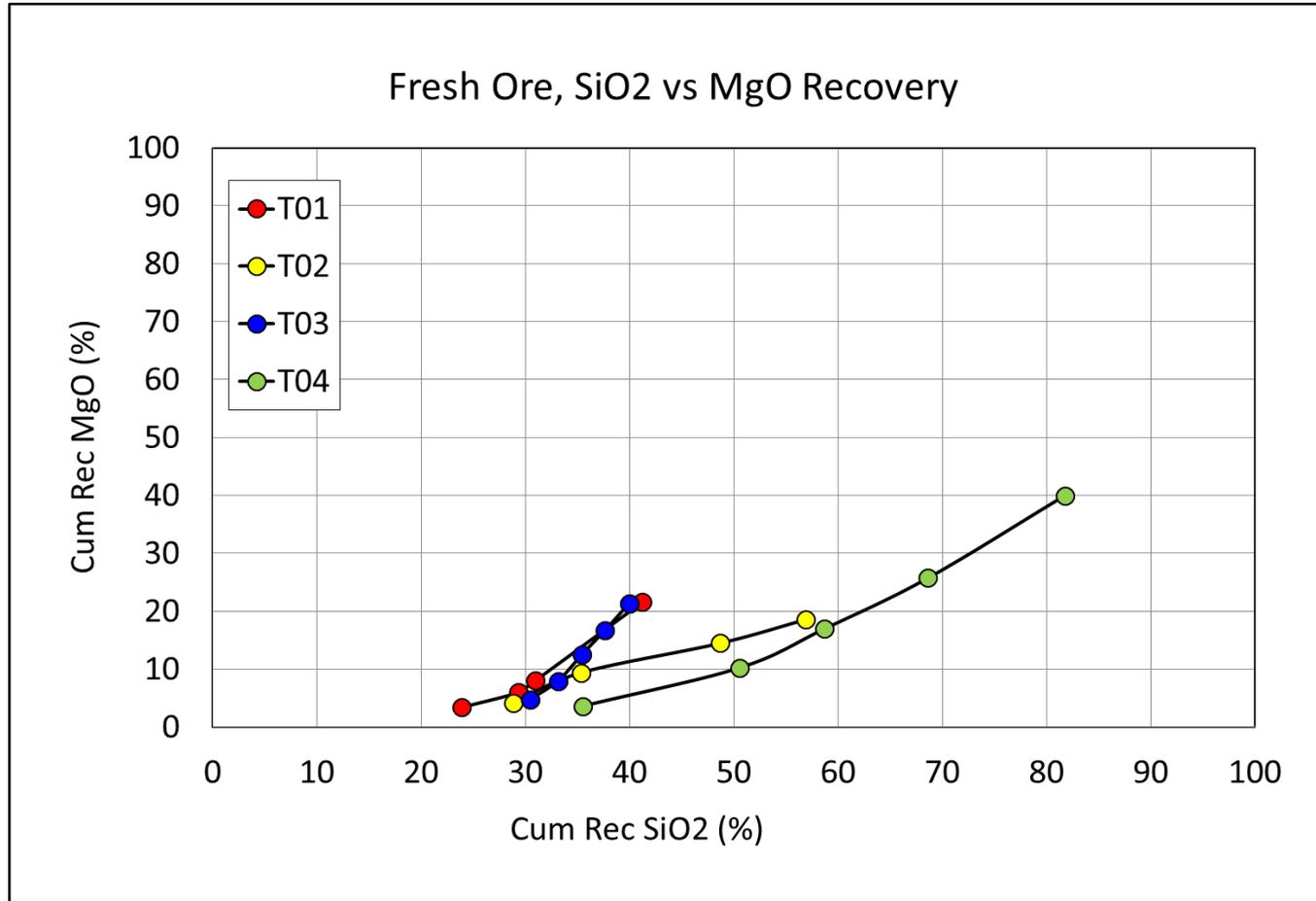
# Silica Flotation: Ground Fresh Ore



- A further silica float was performed to assess a rougher/cleaner configuration (T10).
- This has removed around 61% of SiO<sub>2</sub> and lowered the MgO loss.
- A second test will be performed to optimise.
- The ore contains 4.4%SiO<sub>2</sub> and 43.3%MgO.
- T10 tails contain 2.2%SiO<sub>2</sub> and 43.9%MgO.
- Calcination of float tails will increase the SiO<sub>2</sub> to around 4.2%.

Test	Product	Wt	MgO	Dist	SiO <sub>2</sub>	Dist	S	Dist	Fe <sub>2</sub> O <sub>3</sub>	Dist	MgCO <sub>3</sub>	Dist
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
T01	Si Conc	21.9	41.0	21.6	7.3	41.2	0.2	83.8	1.5	26.8	85.7	21.6
T02	Si Conc	38.7	40.4	37.9	7.5	67.6	0.1	89.8	1.7	51.0	84.6	37.9
T03	Si Conc	21.7	40.8	21.4	7.7	40.0	0.2	74.9	1.5	27.1	85.3	21.4
T04	Si Conc	41.2	39.9	40.0	8.2	81.8	0.1	82.3	1.7	48.2	83.4	40.0
T10	Si Cl Conc	24.3	41.5	23.3	10.9	61.0	0.24	82.3	1.9	31.7	86.8	23.3

# Flotation Tests: Ground Fresh Ore



# Flotation of calcine



- Three flotation tests were performed on calcined magnesite (T05, T06 and T09)
- These yielded much poorer results than “whole of ore” silica floats.
- The table below compares a direct ore silica float (T04) with the three calcine floats.

Test	Product	Wt (%)	MgO (%)	Dist (%)	SiO2 (%)	Dist (%)	S (%)	Dist (%)	Fe2O3 (%)	Dist (%)
T04	Si Conc	41.2	39.9	40.0	8.20	81.8	0.1	82.3	1.70	48.2
	Tail	58.8	41.9	60.0	1.28	18.2	0.02	17.7	1.28	51.8
T05	Si Conc	25.4	76.9	26.5	4.94	17.6	0.21	44.7	1.97	17.1
	Tail	74.6	72.9	73.5	7.86	82.4	0.09	55.3	3.26	82.9
T06	Si Conc	33.4	81.0	35.5	5.18	15.6	0.18	54.0	8.87	39.8
	Tail	66.6	73.7	64.5	14.0	84.4	0.08	46.0	6.74	60.2
T09	Si Conc	61.2	41.4	59.5	8.50	57.7	0.09	52.1		
	Tail	38.8	44.5	40.5	9.82	42.3	0.13	47.9		

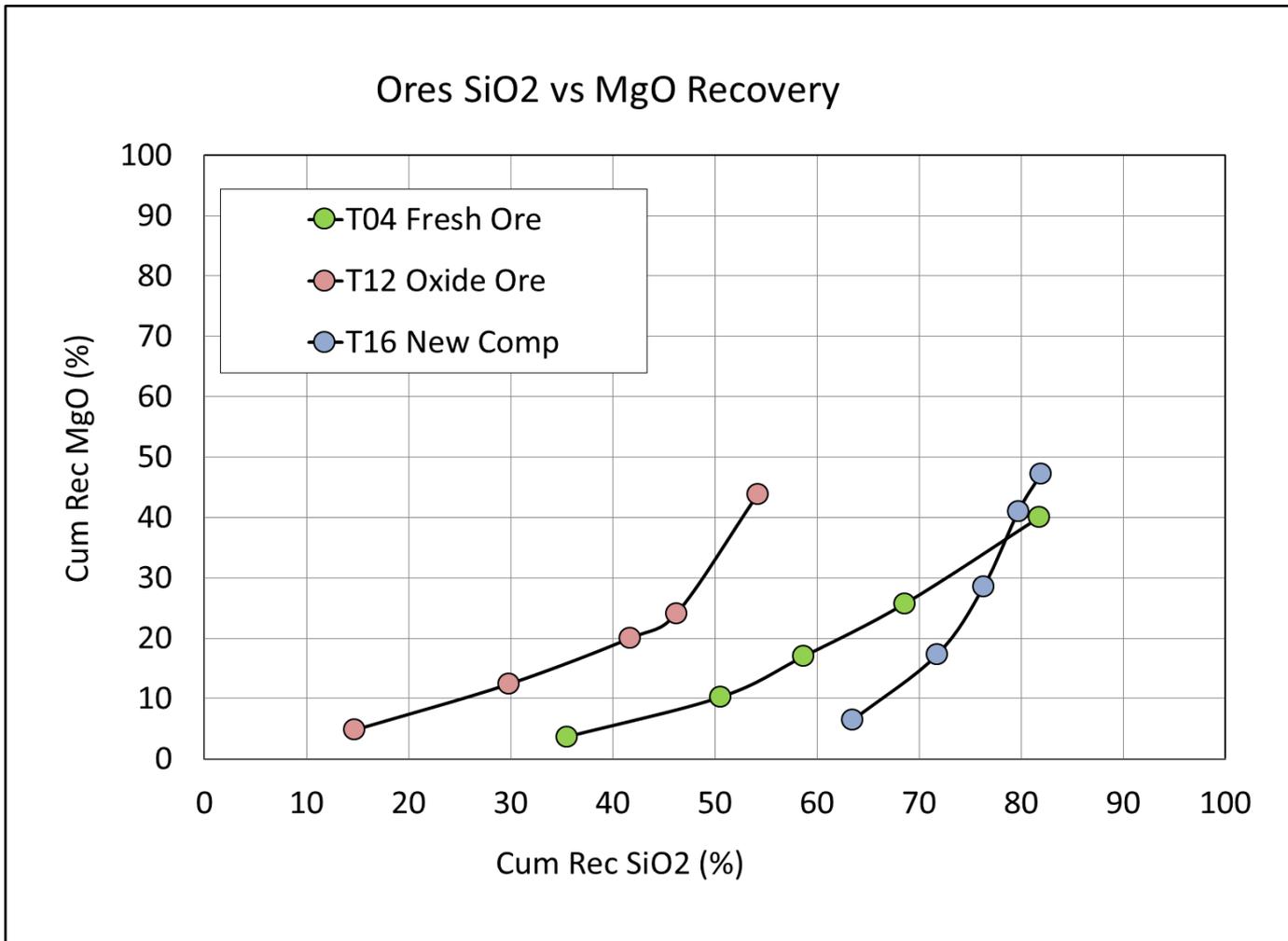
# Flotation of Ore Types



- T14, T04 and T16 compare the three ores tested.
- T12: Oxide Ore
- T04: Fresh Ore
- T16: New Comp
- Results indicate best response (selectivity against SiO<sub>2</sub>) for the New Composite although the Fresh Ore yields a similar result at high silicate recovery.

Test	Product	Wt	MgO	Dist	SiO <sub>2</sub>	Dist	S	Dist	Fe <sub>2</sub> O <sub>3</sub>	Dist
	Rougher	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
T12	Si Ro Conc	45.0	41.2	43.8	7.67	54.2	0.03	71.5	4.48	65.5
	Ro Tail	55.0	43.2	56.2	5.31	45.8	0.01	28.5	1.93	34.5
T04	Si Ro Conc	41.2	39.9	40.0	8.20	81.8	0.1	82.3	1.70	48.2
	Ro Tail	58.8	41.9	60.0	1.28	18.2	0.02	17.7	1.28	51.8
T16	Si Ro Conc	47.5	45.9	47.2	2.50	81.9	0.01	70.4	0.83	48.7
	Ro Tail	52.5	46.5	52.8	0.50	18.1	0.05	29.6	0.79	51.3

# Flotation of Ore Types



- Each type responds well to silicate removal using the following oxide reagent scheme.
- Oxide ore type responds significantly more poorly than Fresh and New types suggesting that oxidation is more important than silica content in flotation response.

HCl Adjust to pH 7.0	Armac C amine collector	Na <sub>2</sub> PO <sub>3</sub> dispersant	CuSO <sub>4</sub> activator	MIBC frother
700-1200 gpt	50 gpt	150 gpt	80 gpt	80 gpt

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700-1200 gpt	50 gpt	150 gpt	80 gpt	80 gpt

# Calcination Comparison



Test No	HY5594	HY5593	HY5787	HY5786	HY6417
Sample Tested	Oxide Comp	Fresh Comp	Oxide Comp Float Tail	Fresh Comp Float Tail	New Comp Float Tail
Sample Size (um)	<300	<300	<300	<300	<300um
Roast Temp (deg)	850	850	850	850	850
Roast Duration (min)	120	120	120	120	120
Feed Mass (gm)	503	500	1320	1355	500.0
Calcine Mass (gm)	267	263	691	382	242
Mass Loss (%)	46.9	47.3	47.6	49.7	51.7
Calcine MgO (%)	63.5	71.4	78.2	78.8	92.5
Calcine SiO2 (%)	11.1	7.12	9.49	4.39	1.40

- Direct calcination of ore types yields poor MgO grade in calcine due Silica dilution.
- Silica is upgraded during the calcination process due to carbonate mass loss.
- Calcination of silica float tails improves MgO grade of calcine but silica is also upgraded.