

Thermal-Pneumatic Reclamation of Molding Sand for Reuse in Core Work

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EDITOR'S NOTE

Following is the text of a technical research report first presented at the 1983 AFS Convention. At the time of writing, Mr. Granlund was National Engineering's Technical Director and Mr. Silsby was the Sand Lab Manager. Further research has followed this original paper and several installations that follow the general concept discussed below now are successfully operating. Please contact National Engineering Company if you are interested in additional information on this subject.

ABSTRACT

Pneumatic scrubbing of green sand systems has been in use for nearly 30 years. Whether the scrubbed sand is used to maintain the purity level of the system or to make facing sand, the residual active clay can be reused.

At present the majority of green sand foundries are disposing of sand that is predominantly molding sand, yet the majority of their new sand goes into core or nobake usage. Molding sands with high clay levels are difficult to reclaim by any dry methods. If the sand is calcined first, we achieve three benefits: removal of a high percentage of organic binders; deactivation of all clays; and a partial removal of clay.

Data from a number of calcine plus pneumatic scrubbing runs are presented both as to physical properties of the sands as well as rebond data. All rebonds were run at 100% reclaimed sand and at the same binder and catalyst level as in the new sand runs.

The use of thermal plus pneumatic scrubbing is a viable method of reclaiming molding sand for reuse in core and nobake work.

INTRODUCTION

Pneumatic scrubbing in green sand systems has been in use for nearly 30 years. In these systems it was not a desire to remove a very high percentage of good clay, but rather to remove a high

percentage of dead clay, charred organics and impurities. Whether the sand is used to maintain the purity level of the system or to make facing sand, the active clay remaining in the sand can be reused.

As the organic nobakes appeared in the foundry industry the pneumatic scrubber was applied to the reclamation of these binders. A more powerful blower, both in horsepower and pressure, was used. In the early days of the nobake reclamation, the feeling was prevalent that the reclaimed sand should have very low residual binder. Maximums mentioned were in the range of

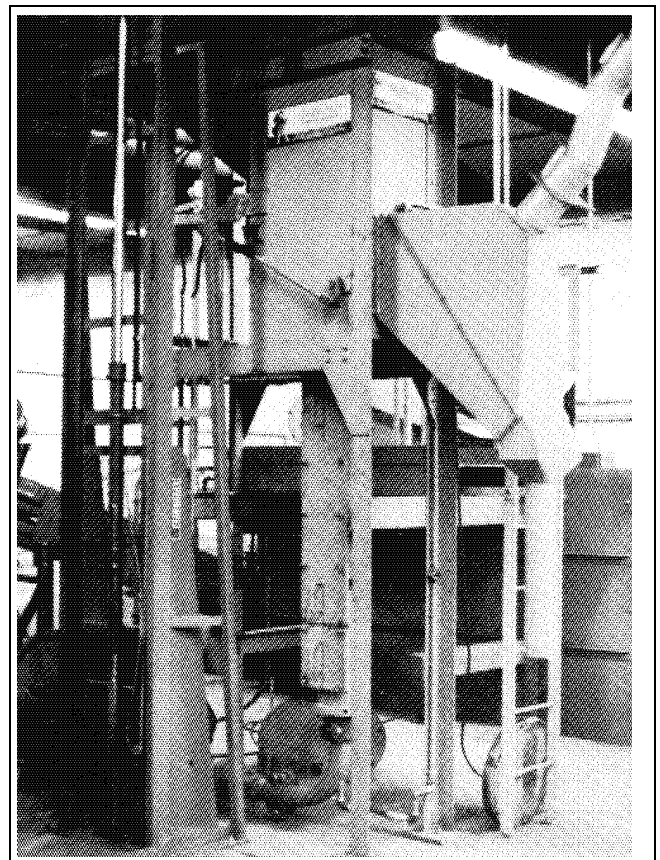


Fig. 1. One cell pneumatic scrubber

0.5% loss on ignition. Many felt that the calcination was the only way to achieve this level of residual binder. As work progressed it was found that a higher controlled level of residual binder could be tolerated. The residual binder is not as detrimental to casting results as an equivalent new binder content. In a properly cleaned sand, the residual binder remains in the crevices of the sand grain and in very angular and rough sand grains, can affect the amount of binder required for rebond. If all binder is removed from the crevices, they must again be filled on rebond.

The percent reduction of residual binder is proportional to the energy input of the system. In gray iron sand, residual binder is not as critical as in steel, but in all systems the consistency of the reclaimed sand is extremely important. The lower the binder removal rate, the greater the danger of an accumulative effect on binder and impurity buildup.

At present, the majority of green sand foundries are disposing of sand that is probably 70 to 80% molding sand and 20 to 30% core sand. The same foundry in new sand purchases is adding 70 to 80% of its sand through the core-room and only 20 to 30% through new sand additions to the molding sand. With ever-increasing high pressures in molding, the foundryman has increased clay additions and therefore has increased the average percent of clay in the disposal sand. This sand, with very high clay content, is very difficult to reclaim by any dry system, including the pneumatic method.

Wet reclamation systems remove the clay very efficiently but with the ever-increasing clay percentages, settling of the removed clay becomes a problem as does sludge disposal. The wet system will not remove a high percentage of the organic, because binders are made waterproof and the scrubbing action is not as intense as in dry scrubbing. Each sand grain is enveloped in a layer of water, which reduces scrubbing action.

If the pneumatic system is used on these high clay systems (AFS clay-over 12%; and active clay-over 8%) the production rate is slowed down. If the sand is calcined first, we achieve three benefits: calcination removes a very high percentage of the organic binder that is on the sand; it kills all of the active clay in the sand;

and it will remove a portion of the clay in the dust collection system. The calciner furnishes sand that is very low in organics, lower in total clay and contains no active methylene blue (MB) clay. The calcined clay can be removed at a rate much greater than for regularly clay bonded sands and produce a sand usable in core or nobake use.

All of the pneumatic scrubbing was done in our laboratory one cell scrubber, Fig. 1. The reason for using the one cell is the smaller sample size required per run. A 300-pound sample can be charged into the unit. The product can be weighed very accurately and both cyclone and dust-collector material can be collected. The results of the one cell have been correlated to expected production rates in production models.

Table 1. B Gray Iron Foundry Sand Data

	Before 750	750#/Hr/Cell Reclaim	Before 1000	1000#/Hr/Cell Reclaim	Before 1500	1500#/Hr/Cell Reclaim	Before 2000	2000#/Hr/Cell Reclaim
12	TR	--	0.2	--	0.1	--	0.2	--
20	0.2	--	0.3	--	0.2	--	0.2	--
30	0.3	0.3	0.3	0.4	0.7	0.4	0.3	0.4
40	5.4	8.3	5.4	6.9	7.0	6.3	5.5	4.8
50	19.2	25.6	18.9	24.7	22.6	22.9	19.8	18.8
70	30.4	33.3	29.5	33.0	31.5	33.2	29.9	30.0
100	29.2	24.8	29.0	26.1	26.1	27.8	28.6	31.3
140	9.6	5.9	10.3	7.1	7.4	7.8	9.9	11.4
200	3.5	1.3	3.6	1.4	2.3	1.6	3.5	2.9
270	0.9	0.3	1.1	0.3	0.8	0.1	1.1	0.4
PAN	1.0	TR	1.1	0.1	0.9	TR	1.1	TR
AFS-GFN	54.51	55.23	65.37	56.76%	60.13	57.37	64.87	62.21%
AFS Clay	11.70%	1.10%	12.82%	1.48%	12.18%	3.80%	11.98%	4.44%
MB Clay	6.21%	0.61%	6.48%	1.01%	6.27%	2.13%	6.28%	2.59%
L.O.I.	6.93%	0.88%	7.12%	1.48%	7.29%	2.28%	7.12%	2.78%
Yield	--	54.8%	--	60.4%	--	68.8%	--	74.4%

PNEUMATIC RECLAMATION

Table 1 gives test data on a typical gray iron molding sand reclaimed pneumatically at various rates. The 750 lb/hr/cell rate gives a very poor yield and still contained 1.10% AFS clay, 0.61% MB clay and 0.88% loss on ignition. There was approximately a 90% reduction in AFS and MB clay, but both are still high due to the extremely high beginning figures. This sand would not be suitable for core usage unless it was cut with a considerable amount of new sand.

The high removal rate on this sand is to be compared with the considerably lower removal rate on the data shown in Table 2. Both are gray iron foundries, but do not use the same binders, additive sands or machines. Because of the lower destruction temperature of southern bentonite, the ratio of southern to western bentonite will affect the reclamation rate as will the various additives in molding sand. This variability in results dictates the need to check each potential reclamation run in the lab.

Table 2. C Gray Iron Foundry Sand Data

	Before 2000#/Hr/Cell	Reclaimed At 2000#/Hr/Cell	Before 1000#/Hr/Cell	Reclaimed At 1000#/Hr/Cell
6	--			
12	0.4		0.5	
20	1.7		1.8	
30	1.7	0.3	1.7	0.1
40	6.8	4.7	6.7	5.2
50	26.1	24.7	26.0	27.2
70	31.1	33.0	30.8	35.4
100	22.1	26.4	22.3	23.8
140	7.1	8.8	7.1	6.7
200	1.6	1.7	1.8	1.1
270	0.5	0.3	0.5	0.1
PAN	0.7	0.3	0.7	0.1
AFS-GFN	56.58	58.89	56.73	55.73
AFS Clay	14.80%	7.60%	14.95%	2.10%
AFS Adj. Clay	11.14%	5.97%	11.32%	1.74%
MB Clay	9.19%	5.25%	9.38%	1.50%
L.O.I.	6.75%	3.19%	6.73%	1.13%
Yield		70.2%		51.7%

scrubbed plus calcined sand would be usable in core sand with normal new sand addition. The LOI of the calcined sand is rather high for a sand calcined to this temperature 1600F (871C).

The slower (2000 lb/hr/cell) rate does not produce a sand appreciably better than the fast rate. Both of the pneumatically scrubbed plus calcined sand would be usable in core sand with normal new sand addition. The LOI of the calcined sand is rather high for a sand calcined to this temperature 1600F (871C).

The sand of Table 3 was a high acid demand sand. Table 4 gives

Table 4. F Foundry - Low Acid Demand Sand Data

	Molding Sand	Scrubbed 1000#/Hr/Cell	Molding Sand Calcined	Calcined Plus Scrub 2000#/Hr/Cell
12	T	--	--	--
20	0.3	T	0.2	T
30	1.8	1.5	1.2	1.0
40	15.6	10.3	11.0	7.6
50	45.3	51.0	39.6	33.0
70	28.9	21.3	35.1	27.2
100	7.9	11.5	11.2	16.3
140	1.3	2.8	0.9	3.1
200	0.5	1.1	0.2	1.1
270	0.1	0.4	0.2	0.4
PAN	0.2	0.1	0.2	0.1
AFS-GFN	45.2	47.93	47.06	51.53
AFS Clay	8.05	1.50	2.75	0.60
MB Clay	3.54	0.77	0.0	0.0
L.O.I.	4.77	1.18	0.10	0.03
Yield	--	71.3	* 1	85.5

Notes: 1. Sand received from automotive foundry unable to know Yield.
2. Yield based on calcined sand submitted to our lab.

ROTARY KILN CALCINATION

Table 3. Y-C Reclamation Runs

	As Received	Heated to 1600F	1600F Reclaimer 4000#/Hr/Cell	2000#/Hr/Cell
6				
12				
20	T	0.2		T
30	0.3	0.3	0.1	T
40	10.3	2.7	5.2	4.4
50	48.8	30.4	39.4	35.8
70	30.5	38.1	37.2	40.8
100	8.2	16.1	12.8	14.2
140	1.7	7.8	4.2	4.3
200	0.2	3.0	0.7	0.5
270	T	0.6	--	--
PAN	T	0.6	--	--
AFS-GFN	45.64	58.52	51.28	50.98
AFS Adj. Clay	6.8	1.8	0.8	0.6
MB Clay	2.7	< 1 ML	<1 ML	<1 ML
L.O.I.	3.27	.57	.12	.13
Yield	--	--	78.0	78.0

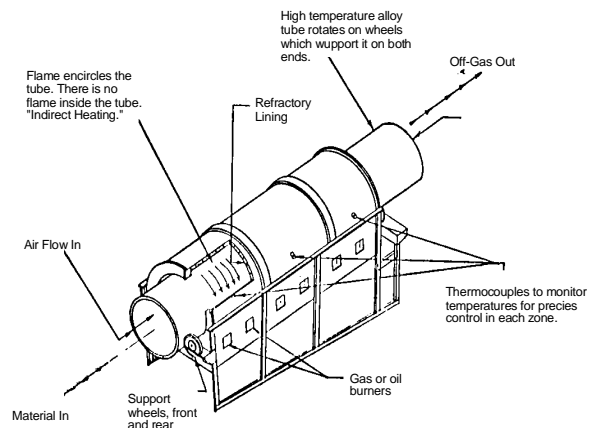
the data on low acid demand lake sand. This straight molding sand was scrubbed at 1000 lb/hr/cell and in addition, some of the sand was calcined prior to scrubbing. The AFS clay in the calcined sand dropped from 8.05% to 2.75%. A great deal of this reduction was due to organics being burned off in the air stream. The 2.75% clay is still too high to use in core sand work. When sand was calcined

One popular method of calcining sand has been the rotary kiln, shown as a schematic in Fig. 2. Table 3 gives the data on runs made on a sand calcined by an externally fired inclined kiln calcining method at 1600F (871C). The sand as received had 6.8% AFS clay; 2.7% MB clay and 3.27% LOI. The reductions in properties are as follows:

	Heated to 1600F (871C)	Calcined & 4000 lb/hr/cell Scrubbing	Calcined & 2000 lb/hr/cell Scrubbing
AFS Clay	73.5%	88.2%	90.3%
MB Clay	98+%	98+%	98+%
LOI	82.5%	96.1%	96.0%

The slower (2000 lb/hr/cell) rate does not produce a sand appreciably better than the fast rate. Both of the pneumatically

Fig. 2 – Rotary Kiln



and scrubbed, a product was produced with 0.60% AFS clay, 0.0% MB clay and 0.03% LOI. This sand could be used in core mix with a normal new sand addition. It is impossible to know what the yield on the calcined sand was since it was shipped to us already processed.

Table 5 gives data on work done to check calcining temperature required. Gray iron foundry sand was calcined at three different

Table 5. B-AC Calcined Sand Results

I. Samples sent from "B" Foundry			
	Barrel #1	Barrel #2	Barrel #3
Loss on Ignition (%)	5.01	5.00	5.08
Methylene Blue Clay (%)	8.0	7.0	7.7
A.F.S. Clay (%)	12.1	11.4	12.5
II. Calcined Samples from "A-C" Calciner			
	900 F	1050 F	1150 F
Loss on Ignition (%)	1.71	0.77	0.58
Methylene Blue Clay (%)	5.9	1.1	0.5
A.F.S. Clay (%)	5.7	3.7	3.1
III. Reclaimed @ 2000#/Hr			
Loss on Ignition (%)	0.97	0.285	0.15

temperatures to check effect of temperature. Each of the sands in turn was scrubbed at 2000 lb/hr/cell. The 900F (482C) and 1050F (565C) sand even after scrubbing had too high residual MB clay and AFS clay to be reusable without a great deal of new sand addition. The 1150F (621C) sand does show definite promise. This sand with normal new sand additions can be used in some liquid organic binder systems.

**FLUID BED CALCINATION
Steel Sand**

The remainder of the data is from work done in fluid bed calciner of the type shown in Fig. 3. A steel foundry sand sample was checked for its pneumatic reclaimability as well as its calcine plus pneumatic reclaimability. The molding sand, as received, contained approximately 5% MB clay, 7% AFS clay and 1.6% LOI. The sample was split into two parts. Part one consisted of two barrels of return sand that were blended and broken up in a vibratory lump-breaker and then given a quick pneumatic scrub. The scrub was followed by calcination and then a second pneumatic scrub. Part two consisted of four drums that were blended and broken up in a vibratory lump-breaker, calcined and pneumatically scrubbed. The reason for the split was to find out if the prescrub produces a better end product than straight calcination plus scrubbing. All of the data appears in Tables 6 and 7 and the foundry is listed as S.

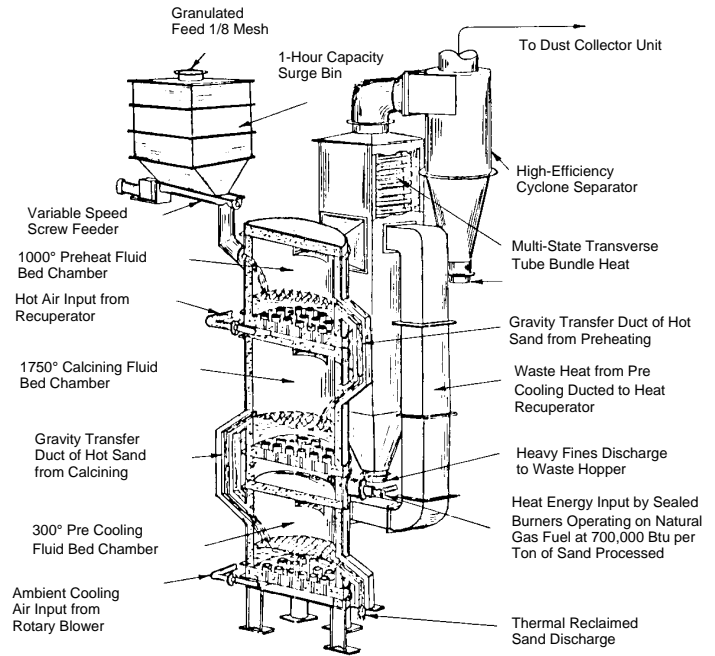


Figure 3

The quick pneumatic scrubbing reduced the properties by the following amounts:

	Drum +1	Drum +2
LOI	41.2%	37.0%
AFS Clay	46.5%	36.6%
MB Clay	43.1%	35.3%

The sand in this condition would have too much clay, both active and dead, to be usable in a core process, but it would be a good sand for reuse as new sand replacement in the green sand system.

Drums 1 and 2 were then calcined at 1685F (918) and the results

Table 6. Foundry Sand Properties

	Drum #1 & #2			Drums #3-6 Composite
	Composite Before	#1 Scrubbed (4000#/Hr)	#2 Scrubbed (4000#/Hr)	
I. As Received:				
L.O.I. (%)	1.65	0.97	0.84	1.61
A.F.S. Clay (%)	7.1	3.7	4.5	6.8
M.B. Clay (%)	5.1	2.9	3.3	5.3
II. Calcined:				
L.O.I. (%)	--	0.06	0.06	0.04
A.F.S. Clay (%)	--	0.70	0.90	1.10
M.B. Clay (%)	--	0.00	0.00	0.00
III. Calcined & Scrubbed:				
L.O.I. (%)	--	0.04	0.04	0.03

Table 7. S Foundry Screen Analysis

Screen	New Sand	Molding Sand As Received	Pneumatically Scrubbed At 4000#/Hr/Cell		Molding Sand As Received	Calcined Sand (1685F)	Calcined Scrubbed 1685F + 400#/Hr
			Drum 1	Drum 2			
12	--	0.2			0.2	--	--
20	--	0.5	0.1	0.2	0.4	--	--
30	0.32	2.9	0.5	0.5	1.8	-1.0	0.4
40	3.52	8.8	3.3	2.8	7.1	6.8	3.2
50	12.46	18.5	11.2	10.1	16.3	21.2	14.1
70	18.34	26.0	21.8	22.8	24.8	29.1	24.5
100	33.46	28.0	34.6	36.5	29.9	32.1	33.6
140	24.6	10.3	19.2	18.8	12.6	8.8	17.1
200	6.4	3.2	7.4	6.7	4.3	1.0	5.4
270	1.1	0.7	1.6	1.4	1.5	--	1.4
PAN	0.2	0.4	0.2	0.1	0.7	--	.04
AFS - GFN	74.7	61.0	74.13	73.3	66.4	57.9	71.0
Surface Area - cm ² /gram	191.2	--	--	--	--	150.1	190.0
Acid Demand:							
PH-5	0.4	--	--	--	--	4.5	3.1
PH-7	-0.1	--	--	--	--	3.5	2.1

are presented in Section 2 of Table 6. The LOI dropped to a very low level, the MB clay is zero indicating complete deadening of the clay and the AFS clay was lowered to less than 1%. The results of the scrubbing on the calcined sands are given in Section 3 of Table 6. The directly calcined sands were as low in properties as the scrubbed plus calcined, except for the AFS clay reading, which was slightly higher. After the calcined samples were pneumatically scrubbed they were as clean as the scrubbed, calcined and scrubbed samples. The direct calcination eliminated dust collector fines that are high in leachable materials. The screen analysis of these sands appears in Table 7.

The calcined plus scrubbed sand was sent to an independent laboratory for rebonding purposes. Table 8 shows the hotbox results of the calcined sand, calcined plus scrubbed and 100% new sand. One point that must be made is that the reclaimed sand was

Table 8. Hot Box Strengths of S Foundry Sand

	Cold Tensile Strength (psi) (Dwell Time in Seconds)					
	20	20	30	40	50	60
Calcined Only (1685F)	0	55	105	125	125	125
Calcined Plus Scrubbed (1685F + 4000#/Hr/Cell)	40	225	255	275	245	250
New Sand	205	350	315	325	330	316

Note: 1. Calcined and calcined plus scrubbed were run at 100%, no new sand addition.
2. Binder and catalyst levels same for all three, no catalyst adjustment.

run at 100% and that the same binder and catalyst contents were used in the reclaimed sand as in the new sand. In normal practice, some percentage of new sand would be added to the reclaimed

sand to maintain the system volume. Modifications in the catalyst content or type of catalyst can be made to compensate for small residuals in the reclaimed sand. In the hotbox test, reclaimed sand is low in front end tensile strength but does achieve 85% of the strength of 100% new sand.

The same sand was bonded in nobake. The reclaimed sand increased the strip time by double, but the tensile strength at 24 hours was higher and the scratch hardness was equal.

Gray Iron Sands

Two gray iron foundry sands were run through the fluid bed calciner. The first sample was from a gray iron captive production foundry (GC). The molding sand as received had 6.35% LOI, 13.3%

AFS clay and 8.2% MB clay. Calcination at 1685F (918C) dropped the LOI to below 0.25%, the AFS clay to below 0.1% and the MB clay to 0.0%. The completed data is on Table 9. The calcined-plus scrubbed sand had a LOI lower than the new sand and its screen analysis was very close to the new sand.

The calcined, calcined-plus scrubbed and new sands were compared in the hotbox. The data is presented in Table 10. The calcined-only sand was not rebondable in hotbox. The calcined-plus scrubbed achieved 70-90% of new sand strength with the same binder and resin addition. As in the steel foundry results, the front end strength was low and again no new sand was added.

The second gray iron sand was from a jobbing shop. The molding sand as received by us was very close in properties to the GC foundry except that the LOI was about 1% lower. The sand was begun through the fluid bed at a temperature of 1685F (918C) and each two hours the temperature was lowered by 100F (37C). The last sand was calcined at 1285F (696C). Because we did not have enough sand to run at least one whole drum at each temperature, all of the sand was run at 1685F (918C). All of the sand that was run at 1585F (863C) and half of the sand that was run at 1485F (807C) were combined into drum A. Drum B was composed of half of the 1485F (807C) calcined sand. Table 11 gives the data on the combined drums.

Table 9. Gray Iron Captive Foundry Sand Data

PROPERTIES		SCREEN ANALYSIS				
		Screen	New Sand	Molding Sand As Received	Calcined Sand 1685F	Calcined & Scrubbed 1685F 4000#/Hr
I. As Received						
L.O.I.	6.35%	12	--	0.2	--	--
A.F.S. Clay	13.3%	20	--	0.6	T	T
M.B. Clay	8.2%	30	--	1.4	0.4	0.2
		40	5.6	14.7	6.1	4.4
II. Calcined at 1685F						
L.O.I.	0.22%	50	33.5	41.2	36.2	29.5
A.F.S. Clay	0.80%	70	33.7	27.8	34.0	36.4
M.B. Clay	0.00%	100	19.8	11.1	18.8	23.7
		140	5.6	2.4	3.4	5.1
		200	1.2	0.5	0.8	0.8
III. Calcined at 1685F and Scrubbed at 4000#/Hr						
L.O.I.	0.45%	270	0.4	0.2	0.2	T
A.F.S. Clay	0.30%	PAN	0.2	0.1	0.2	T
M.B. Clay	0.00%					
		AFS-GFN	54.5	46.7	52.0	54.1
		Surface Area cm ² /g	139.1	--	131.6	138.5
		% Fines	1.8	0.8	1.2	0.8
		No. of Screens	3	4	3	3
		Acid Demand:				
		PH-5	5.9	--	21.3	10.3
		PH-7	4.9	--	19.5	9.5
		Loss on Ignition	0.08	6.35	0.22	0.045
		Grain Shape	Rounded	--	Rounded	Rounded

Table 10. Hot Box Strengths of GC Foundry Sand

	Cold Tensile Strength (psi) (Dwell Time in Seconds)					
	10	20	30	40	50	60
Calcined Only (1685F)	0	0	0	0	0	0
Calcined Plus Scrubbed (1685F + 4000#/Hr/Cell)	0	175	300	355	355	365
New Sand	330	430	475	575	490	410

Note: 1. Calcined and calcined plus scrubbed were run at 100%, no new sand addition.
2. Binder and catalyst levels same for all three, no catalyst adjustment.

level. The lower temperature 1285-1485F (696-807C) sand increased the strip time appreciably over the higher temperature sand. There was also an appreciable drop in tensile.

Manganese Steel Sand

One manganese foundry sand was calcined-plus pneumatically scrubbed. The properties of the sand as received, scrubbed, calcined-only and calcined-plus scrubbed are listed in Table 12. The screen analysis of each sand is also listed in this table. The MB clay after calcining had been reduced by 100%, but the AFS clay reduction was only 81.6%. The 0.9% residual AFS clay was the highest of all of the runs made on molding sand. This may be

The higher temperatures did lower the AFS clay more than lower temperatures and the LOI followed the same trend. In all cases, even the 1285F (696C) run, the MB clay was lowered to zero, indicating all clay had lost its ion exchange ability.

Very little rebond work was done on this sand. The 1485F calcined-plus scrubbed sand increased the strip time in a furan nobake and did lower the tensile strength at a 100%

Table 11. Gray Iron Jobbing Foundry Sand Data

PROPERTIES		SCREEN ANALYSIS						
		Screen	New Sand	Molding Sand As Received	Calcined Only		Calcined & Scrubbed	
					1285-1485F	1485-1685F	1285-1485F 4000#/Hr	1485-1685F 4000#/Hr
I. As Received								
L.O.I.	5.3%	12	--	.1	--	--	--	--
A.F.S. Clay	13.2%	20	--	1.7	--	--	--	--
M.B. Clay	8.0%	30	--	2.1	0.2	0.8	--	--
		40	0.6	7.1	3.6	2.4	1.0	--
II. Calcined 1285-1485F 1485-1685F								
L.O.I.	0.33% 0.24%	50	10.5	28.1	19.8	19.2	8.9	13.8
A.F.S. Clay	2.26% 1.90%	70	25.5	28.8	29.8	36.2	25.3	30.7
M.B. Clay	0.00% 0.00%	100	39.6	21.7	30.4	32.8	40.8	37.9
		140	18.1	6.6	12.5	7.5	18.5	13.4
		200	4.6	2.0	2.8	1.0	4.5	2.4
III. Calcined Plus Scrubbed at 4000#/Hr								
L.O.I.	0.10% 0.09%	270	0.8	0.7	0.6	0.2	0.8	0.4
A.F.S. Clay	0.60% 0.50%	PAN	0.4	1.0	0.2	0.4	0.2	--
M.B. Clay	0.00% 0.00%							
		AFS-GFN	72.1	57.3	64.0	59.0	72.1	65.3
		Surface Area cm ² /g	193.7	--	168.5	156.5	193.16	173.1
		% Fines	5.8	--	3.8	1.6	5.5	2.8
		No. of Screens	4	--	4	3	3	4
		Acid Demand:						
		PH-5	0.6	--	14.5	17.0	5.1	6.0
		PH-7	0.3	--	12.2	12.6	3.7	4.4
		Loss on Ignition	0.07	--	0.33	0.24	0.10	0.09
		Grain Shape	Rounded	--	Rounded	Rounded	Rounded	Rounded

Table 12. Manganese Steel Foundry Sand A Data

PROPERTIES		SCREEN ANALYSIS				
		Screen	New Sand	Molding Sand As Received	Calcined Sand 1685F	Calcined & Scrubbed 1685F 4000#/Hr
I. As Received						
L.O.I.	1.0%	12	--	--	--	--
A.F.S. Clay	4.9%	20	--	0.4	0.1	--
M.B. Clay	3.3%	30	T	0.8	0.1	--
		40	2.2	8.2	2.5	1.6
II. Scrubbed Only (2000#/Hr/Cell)		50	17.6	22.3	24.6	17.4
L.O.I.	0.3%	70	27.9	37.7	28.7	31.0
A.F.S. Clay	1.25%	100	33.5	22.9	29.6	33.2
M.B. Clay	1.0%	140	15.6	6.4	11.6	13.6
		200	2.6	0.9	2.1	2.8
III. Calcined Only		270	0.4	0.2	0.5	0.4
L.O.I.	0.1%	PAN	0.2	0.2	0.2	--
A.F.S. Clay	0.9%	AFS-GFN	65.7	55.21	61.8	64.5
M.B. Clay	0.0%	Surface Area cm ² /g	147.5	--	--	140.0
		% Fines	3.2	--	2.8	3.2
IV. Calcined Plus Scrub		No. of Screens	4	--	4	4
L.O.I.	0.021%	Acid Demand:				
A.F.S. Clay	0.4%	PH-5	6.5	--	--	2.3
M.B. Clay	0.0%	PH-7	8.4	--	--	1.7
		Loss on Ignition	0.09	--	0.10	0.021
		Grain Shape	Rounded	--	Rounded	Rounded

Table 13. Rebond Strengths of A Sand

I. Hot Box Data	Cold Tensile Strength (psi) (Dwell Time in Seconds)					
	10	20	30	40	50	60
Calcined Plus Scrubbed (1685F + 4000#/Hr/Cell)	180	350	360	390	385	360
New Sand	185	445	525	485	470	435
Tensile Strength (psi)/Scratch Hardness						
II. Cold Box Data	Immediate	30 Min.	Overnight	Overnight (100% R.H.)		
Calcined Plus Scrubbed (1685F + 4000#/Hr/Cell)	150/68	180/72	210/70	150/67		
New Sand	195/69	210/76	235/71	180/65		

Note: 1. Calcined and calcined plus scrubbed were run at 100%, no new sand addition.
2. Binder and catalyst levels same for all three, no catalyst adjustment.

due to the fact that the bond was 100% western bentonite. The calcined-plus scrubbed sand was down to 0.4% AFS clay and Table 13 gives rebond test data.

As in the other rebond tests the reclaimed sand was run at 100% and no binder or catalyst adjustments were made. The 100% reclaimed sand achieves 70-90% of the strength of 100% new sand.

CONCLUSIONS

The use of thermal plus pneumatic reclamation is a viable method of reclaiming molding sand for reuse in core sand work. The thermal portion adds to the cost of reclamation and it is the author's opinion that the various calciner manufacturers be contacted to get an evaluation of their equipment.

The Btu's required per ton of sand reclaimed will vary from manufacturer to manufacturer as will the total operating cost and total installation costs. Because of the variability of reclaimed results in identical equipment, it is strongly recommended that trial runs be made on reclaimed molding sands to be used in core work.

The pneumatic portion of these reclamation runs have generally had a cost of less than \$3/ton of operating total cost. This cost includes lump-breaking, magnetic separation, transport between units, pneumatic reclamation and dust collection for the lump-reducer and the pneumatic reclaimers. This cost does include replacement parts, maintenance and operation; it does not include amortization.

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