

Non-Hazardous Pre-Combustion Removal of Mercury at the Power Plant

MagMillä Technology

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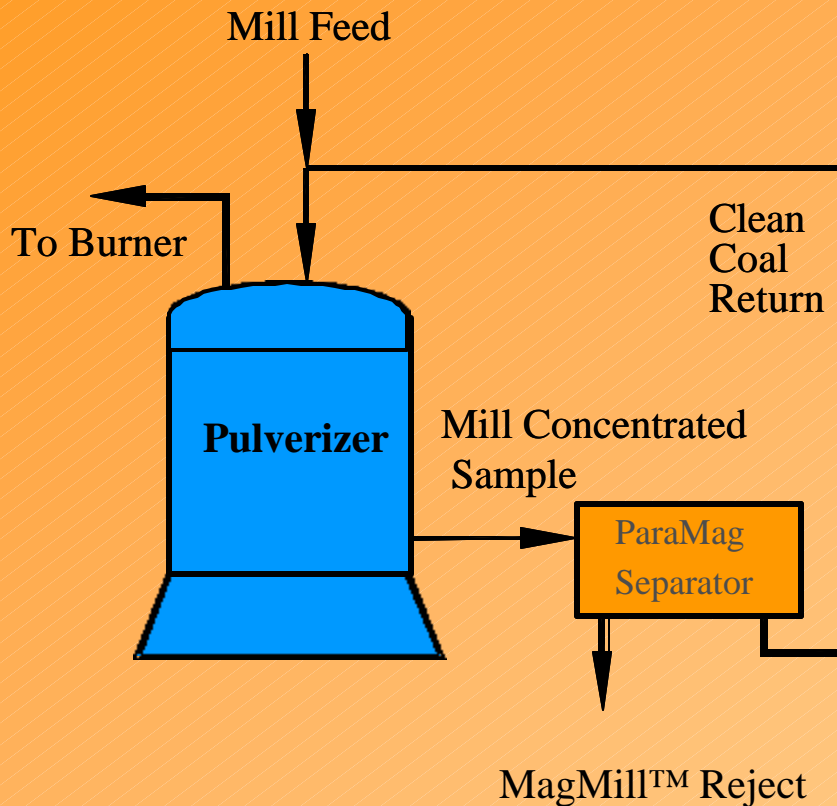


MagMillä Technology

Feature

Advantages

Benefits



More effective than wet coal cleaning

Separation of hard & abrasive minerals

No water

No additives

Scaleable

Mill

Reduces wear, power draw

Burners & Boilers

Product burns faster

Fusion temp increased

Reduced water wall wastage

NO_x Reduction

Increased fineness to pipes

Reduced arsenic to SCR

Fuels Procurement

Reduces overall costs

Coals Tested

- Dry Magnetic Separation 70+
- Samples from Pulverizers from
Power Plants in PA, WV, IL & OH 8
- Alpha Prototype MagMill™ 4
- Beta Prototype MagMill™ 2
- Trace Metal Separation 17

Beta Prototype MagMillä



Beta Prototype MagMillä Results

	Upper Freeport				Lower Kittanning			
	Concentration Lb/MBtu			Recovery %	Concentration Lb/MBtu			Recovery %
	Product	Reject	Feed	Product	Product	Reject	Feed	Product
Ash	7.2	17.0	16.3	44.1	10.4	12.9	17.3	60.2
Sulfur	0.9	2.6	2.2	39.1	2.7	3.7	4.6	58.0
Pyritic	0.2	1.9	1.2	20.0	1.8	2.7	3.2	56.3
Sulfate	0.0	0.0	0.0		0.0	0.0	0.0	57.3
Organic	0.6	0.7	1.0	61.1	0.9	1.0	1.4	61.9
HGI				68				78

Effects of MagMillä Processing on Ash Fusion Temperatures

Beta Prototype MagMillä

	Upper Freeport			Lower Kittanning		
	Temperature, Deg. F			Temperature, Deg. F		
	Product	Feed	Reject	Product	Feed	Reject
Initial Deformation	2599	2228	2092	2328	2318	2338
Softening	2692	2400	2215	2414	2476	2555
Hemispherical	2700+	2510	2376	2505	2525	2606
Fluid	2700+	2579	2489	2622	2621	2685
		Ratios			Ratios	
Base/Acid*	0.22	0.29	0.34	0.39	0.50	0.63
Silica/Alumina *	2.0	2.2	2.3	1.8	2.0	2.3
Iron/Calcium	2.9	5.9	14.4	14.5	20.0	68.3
Iron/Dolomite	2.2	4.2	8.3	10.3	13.6	29.4
Dolomite %	26.1	16.1	9.6	8.4	6.4	3.1
Total Alkalies	3	4	3	1	2	2

Trace Metal Measurements

Beta Prototype MagMillä

Upper Freeport Run #6

	Concentration Lb/TeraBtu*			Recovery
	Product	Reject	Feed	%
	Product			
Thallium	28	176	118	24
Arsenic	1087	5878	4073	27
Lead	278	1237	912	31
Mercury	11	43	33	33
Nickel	562	1578	1394	40
Selenium	79	213	192	41
Manganese	1027	2629	2425	42
Copper	580	1392	1324	44
Cobalt	163	340	348	47
Molybdenum	108	167	203	54
Chromium	1087	1052	1724	63
Zinc	1148	1083	1807	64
Vanadium	1390	866	1970	71
Beryllium	73	37	99	73
Cadmium	13	5	16.	77
Antimony	14	5	18	78

Lower Kittanning Run #4

	Concentration Lb/TeraBtu*			Recovery
	Product	Reject	Feed	%
	Product			
Thallium	28	90	72	38
Mercury	15	38	34	44
Arsenic	309	617	624	50
Nickel	484	901	946	51
Lead	477	712	850	56
Manganese	806	1186	1429	57
Selenium	316	380	520	61
Zinc	1008	1186	1647	61
Molybdenum	134	123	203	66
Cadmium	8	7	11	68
Cobalt	168	126	241	70
Chromium	1143	783	1602	71
Copper	806	545	1128	72
Vanadium	1143	641	1536	74
Beryllium	54	24	70	78
Antimony	13	3	16	84

One Tera = 10^{12} = one million million

Comparison of Base Case & MagMillä Plants

	Base Case	MagMillä
Plant MW	1,150	1,150
Plant Heat Rate	9,560	9,560
Operating Hours per Year	7,090	7,090
MW-Hr Generation	8,165,800	8,165,800
As-Delivered Eastern US Bituminous Coal		
Million Tons Coal per Year	3.05	3.10
Price per Ton Coal - 1999 \$	31	31
Ash (Wt.%)	8.9	8.9
Sulfur (Wt.%)	1.7	1.7
Btu/Lb	12,800	12,800
Coal Delivered to Burner		
Tons Coal per Year	3.05	3.00
Ash (Wt.%)	8.9	6.8
Sulfur (Wt.%)	1.7	1.3
Btu/Lb	12,800	13,000
MagMill Refuse to Disposal		
Million Tons Refuse per Year		0.14
Ash (Wt.%)		52
Sulfur (Wt.%)		10
Btu/Lb		7,100

Estimated Capital & Operating Costs

MagMillä Retrofit Installation

1150 MW Coal Fired Power Plant

Capital Cost, \$	\$	9,200,000
Operating Cost, \$/T Feed to Pulverizer		
Depreciation, 25 years Straight Line	\$	0.13
Maintenance @ 5% of Capital	\$	0.15
Power @ 0.021\$/kW-Hr @ 4 kW-Hr/T	\$	0.08
Water @ \$0.5/1000 Gallons	\$	0.01
Labor @ 53,500\$/Yr	\$	0.02
Total Estimated Operating Cost	\$	0.39
\$/TPulverizer Feed		
Other Costs, \$/T		
Bottom Ash & Fly Ash Disposal	\$	3
MagMill Refuse Disposal	\$	8

Potential Value of the MagMillä to the Coal-Fired Power Industry

Case	Potential Benefits	Potential Annual Savings For Plant (\$/Million)
Mine-Mouth Power Generation	Less deep coal cleaning at mine Less wet refuse	\$19
5% Lower Non-Fuel Operating Expenses	Lower generating costs by 0.2 mills/kW-Hr	\$1.6
10% Extra Generating Capacity	115 MW extra capacity and lower emissions	\$27
Reduced Mercury to the Burner	Less use of activated carbon	\$22

Conclusions

- Beta prototype MagMill has been tested
- Benefits need to be confirmed by commercial demonstration
- ETCi is seeking partners for this endeavor

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