Fate of Mercury in Synthetic Gypsum

DOE/NETL Mercury Control Technology R&D Program Review

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December 12, 2007

Presentation Outline

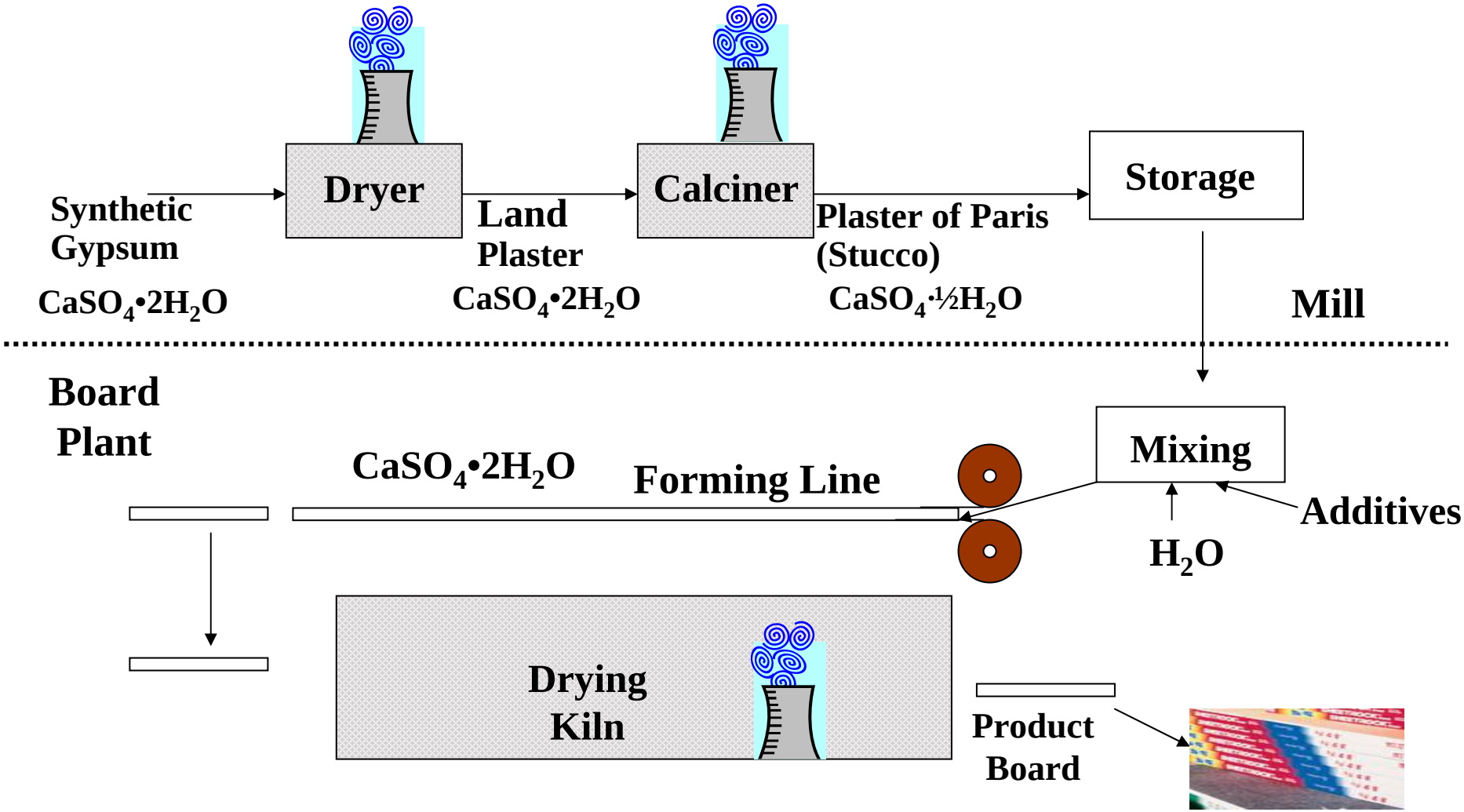
- Project Test Matrix (what synthetic gypsum sources, why)
- Wallboard Production Process
- Sample Collection Sites (where in the process)
- Ontario Hydro Results (% Hg Released)
- Bulk Samples Results (% Hg Loss)
- Wallboard Industry Estimates
  (Based on project results and annual wallboard industry usages)
- Extrapolated Industry Estimates
  (Compared to national mercury emissions)

USG/ DOE The Fate of Mercury in Synthetic Gypsum Used for Wallboard Production – Project Test Matrix

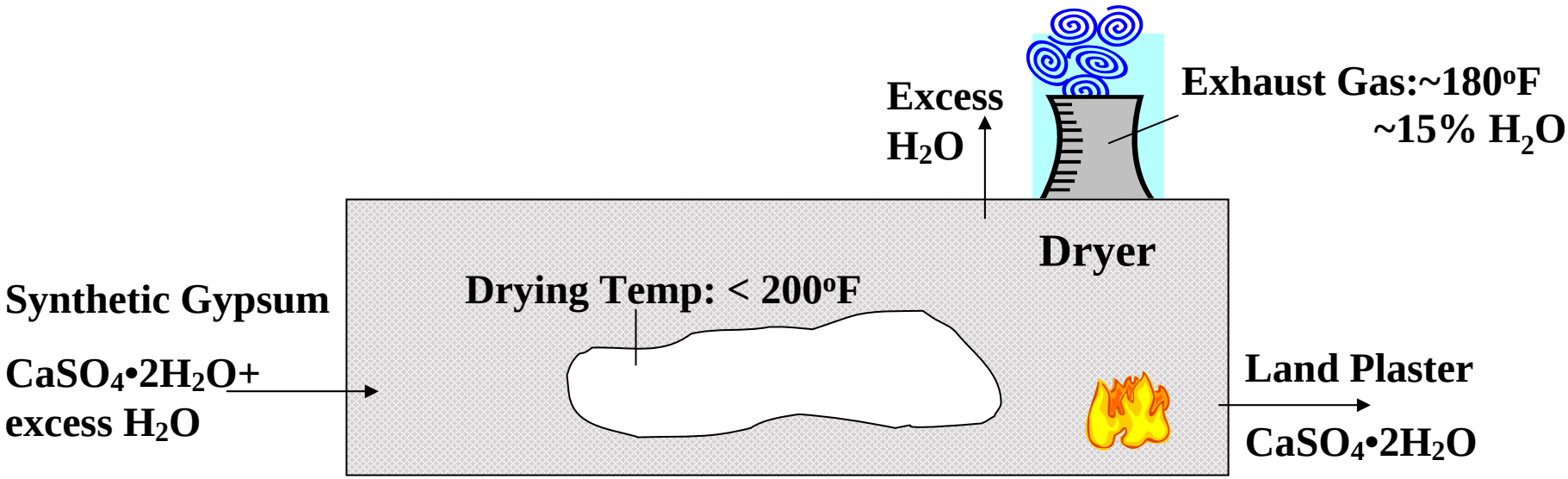
Task	1	2	3	4	5	6	7
Power Plant	A	A	B	C	E	E	F
Coal Type*	HS Bit	HS Bit	HS Bit	TX lignite	HS Bit	HS Bit	PRB
FGD Reagent	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
Forced Ox Mode	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ
Gypsum Fines Blow Down?	Low	Low	High	No	High	High	Varied
SCR Status	On Line	Bypassed	On Line	No SCR	Bypassed	Bypassed	On Line
USG Plant	1	1	2	3	4	4	5
FGD Hg Control Additive?	No	No	No	No	No	Yes TMT-15	No

*HS Bit – High Sulfur Bituminous; TX lignite – Texas lignite; PRB – Powder River Basin

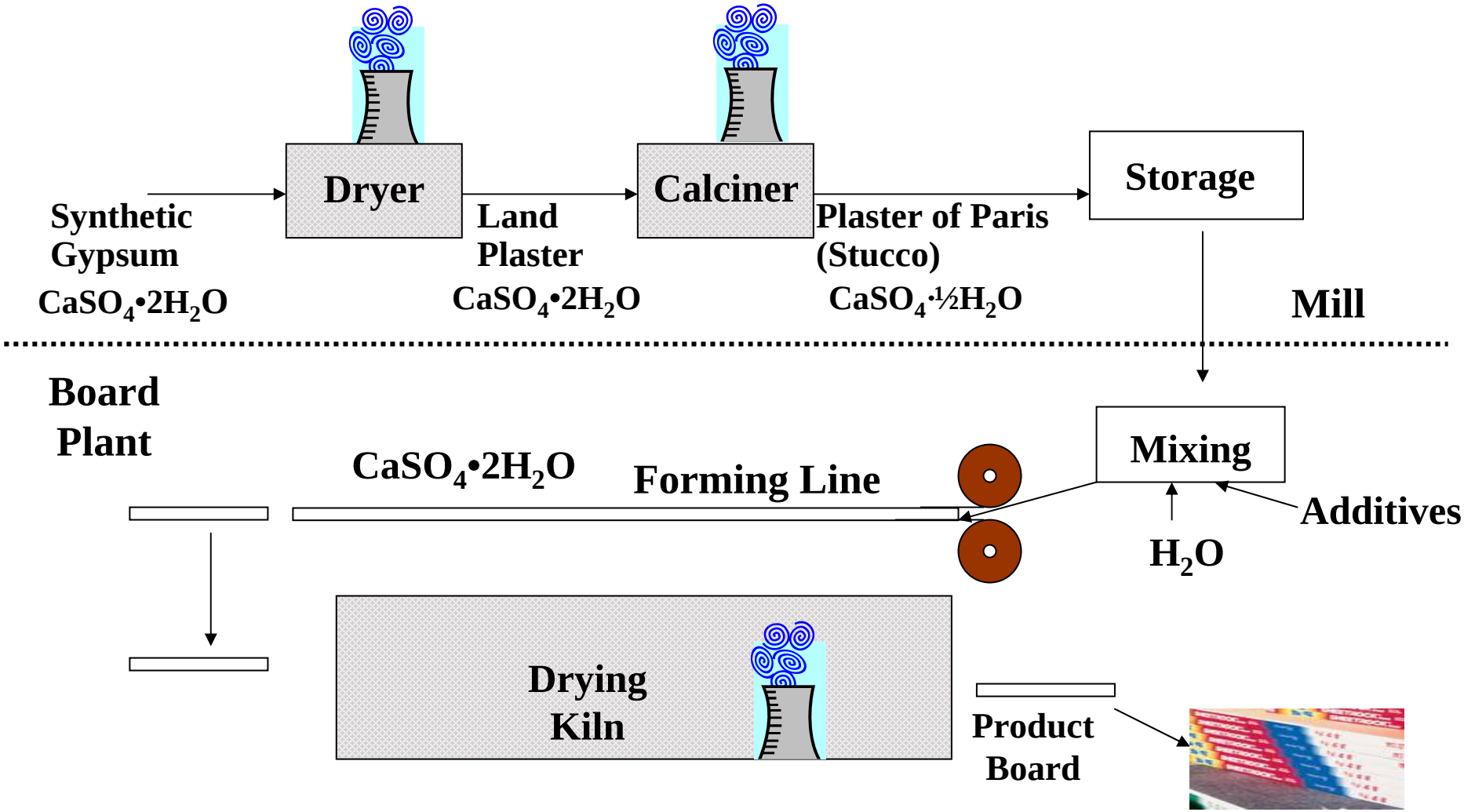
Simplified Flow Diagram of Synthetic Gypsum used for Wallboard Production



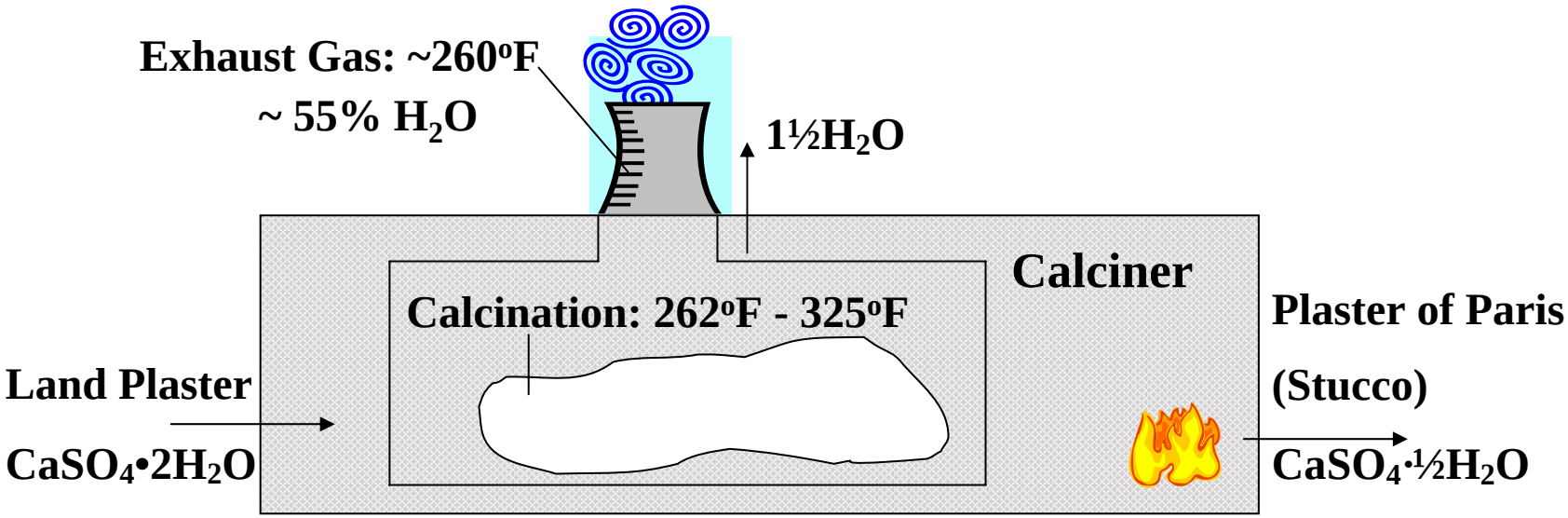
Mill Dryer



Simplified Flow Diagram of Synthetic Gypsum used for Wallboard Production



Mill Calciner



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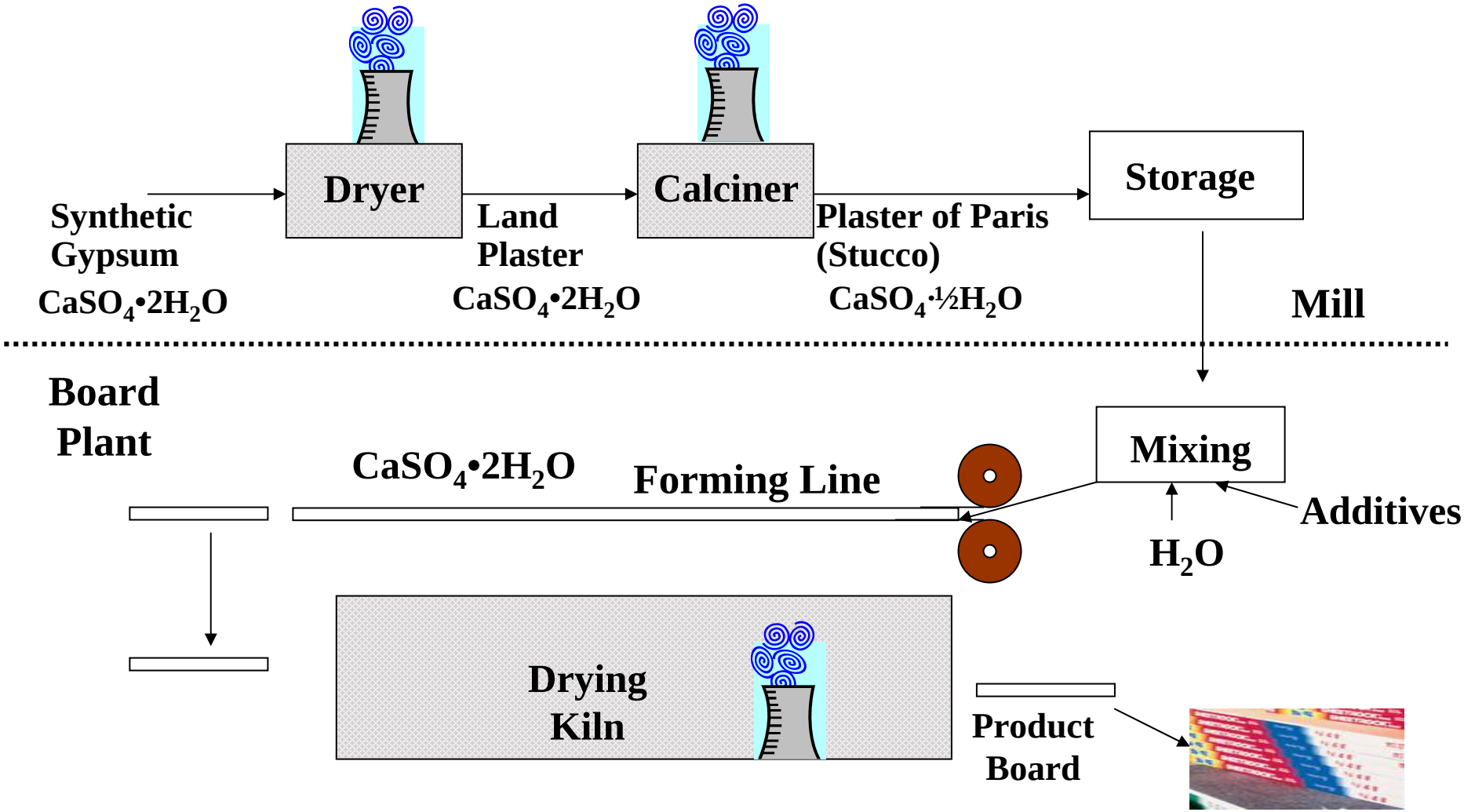
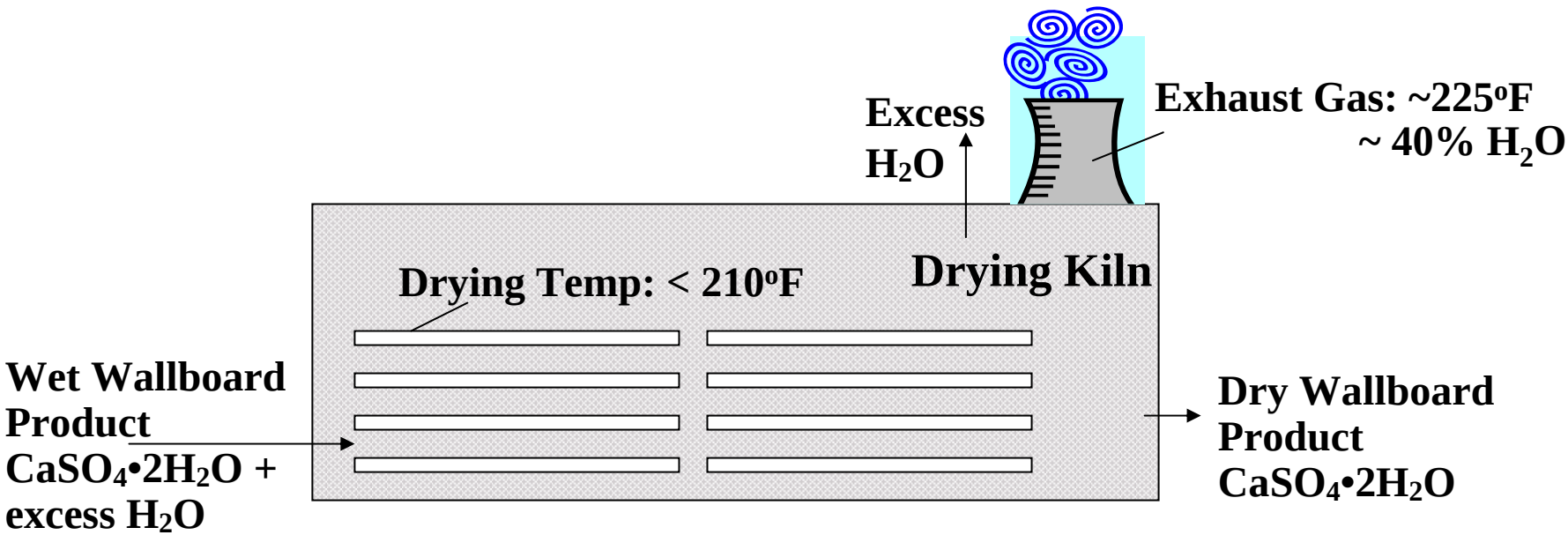
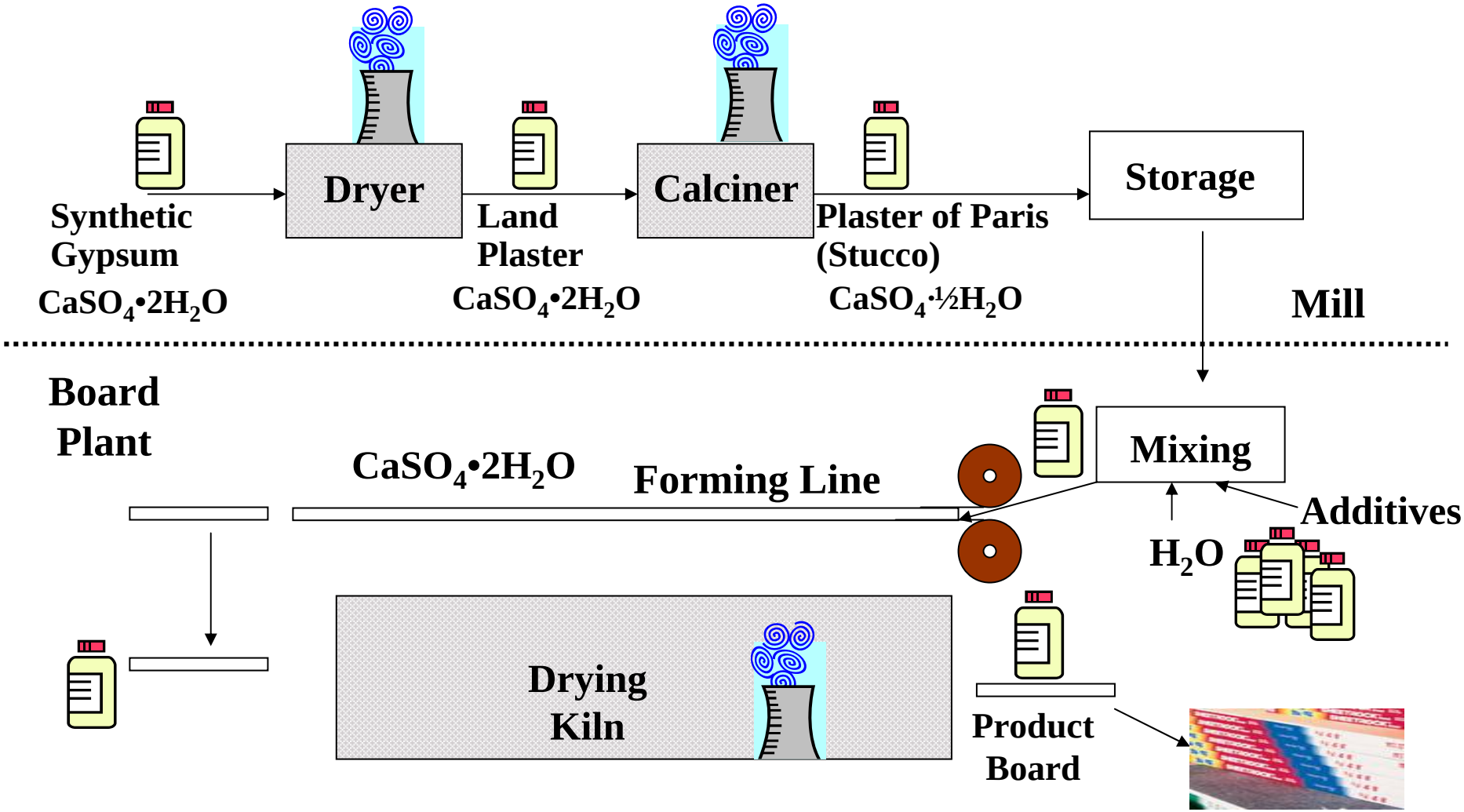


Board Plant Dryer (Kiln)



Sample Collection Sites



Ontario Hydro Results
Percent of Total Mercury Released

Task Parameters (Incoming Hg content)	Dryer	Calciner	Kiln	Plant Emissions (g/hr)
Task 1 HS Bit w/SCR (0.96 ppm Hg)	1%	2%	2%	4.1
Task 2 HS Bit w/o SCR (1.1 ppm Hg)	<1%	3%	5%*	7.8 *
Task 3 High Fines Blow Down (0.21 ppm Hg)	1%	41%	14%*	8.2 *
Task 4 TX Lignite (0.53 ppm Hg)	<1%	<1%	<1%	0.3
Task 5 High Fines Blow Down (0.20 ppm Hg)	<2%	50%	<2%	2.0
Task 6 High Fines Blow Down w/TMT-15 (0.15 ppm Hg)	4%	45%	6%	1.4
Task 7 PRB Coal (1.1 ppm Hg#)	<1%	15%	3%	4.2

*** Losses in the Dryer Kiln for Tasks 2 &3 are estimated based on solids analysis**

 # More recent testing indicates a lower mercury content (~0.5 ppm) with improved fines blowdown.

Ontario Hydro Results – Speciation

	Dryer (%)			Calciner (%)			Kiln (%)		
	Hg^P	Hg^{+2}	Hg^0	Hg^P	Hg^{+2}	Hg^0	Hg^P	Hg^{+2}	Hg^0
Task 1	**3**	**--**	**97**	**5**	**3**	**92**	**2**	**7**	**91**
Task 2	**5**	**--**	**95**	**1**	**10**	**89**	**NA**	**NA**	**NA**
Task 3	**1**	**68**	**31**	**0**	**1**	**99**	**NA**	**NA**	**NA**
Task 4	**4**	**11**	**86**	**28**	**10**	**62**	**0**	**35**	**65**
Task 5	**2**	**22**	**79**	**0**	**1**	**99**	**1**	**23**	**84**
Task 6	**2**	**44**	**54**	**3**	**2**	**95**	**0**	**0**	**100**
Task 7	**0**	**13**	**87**	**0**	**16**	**84**	**0**	**5**	**95**

Percent of Total Mercury Loss: Bulk Samples Results

average of 3 ± Std dev.

(Ontario Hydro Results for comparison)

	Dryer (OH)	Calciner (OH)	Kiln (OH)
Task 1	**1.3 ± 4.0 (1%)**	**1.4 ± 2.5 (2%)**	**-0.9 ± 6.8 (2%)**
Task 2	**3.7 ±1.3 (<1%)**	**8.4 ± 1.4 (3%)**	**5.5 ± 2.4 (N/A)**
Task 3	**-1.5 ± 13 (1%)**	**43 ± 3 (41%)**	**14 ± 6 (N/A)**
Task 4	**-2.3 ± 6.1 (<1%)**	**6.6; 3.6 (<1 %)**	**4.6; 6.1 (<1%)**
Task 5	**13 ± 6 (<2%)**	**30 ± 6 (50%)**	**-3.4 ± 2.3 (<2%)**
Task 6	**0 ± 3 (4%)**	**35 ± 5 (45%)**	**-19 ± 4 (6%)**
Task 7	**5 ± 6 (<1%)**	**23 ± 1 (15%)**	**-12 ± 13 (3%)**

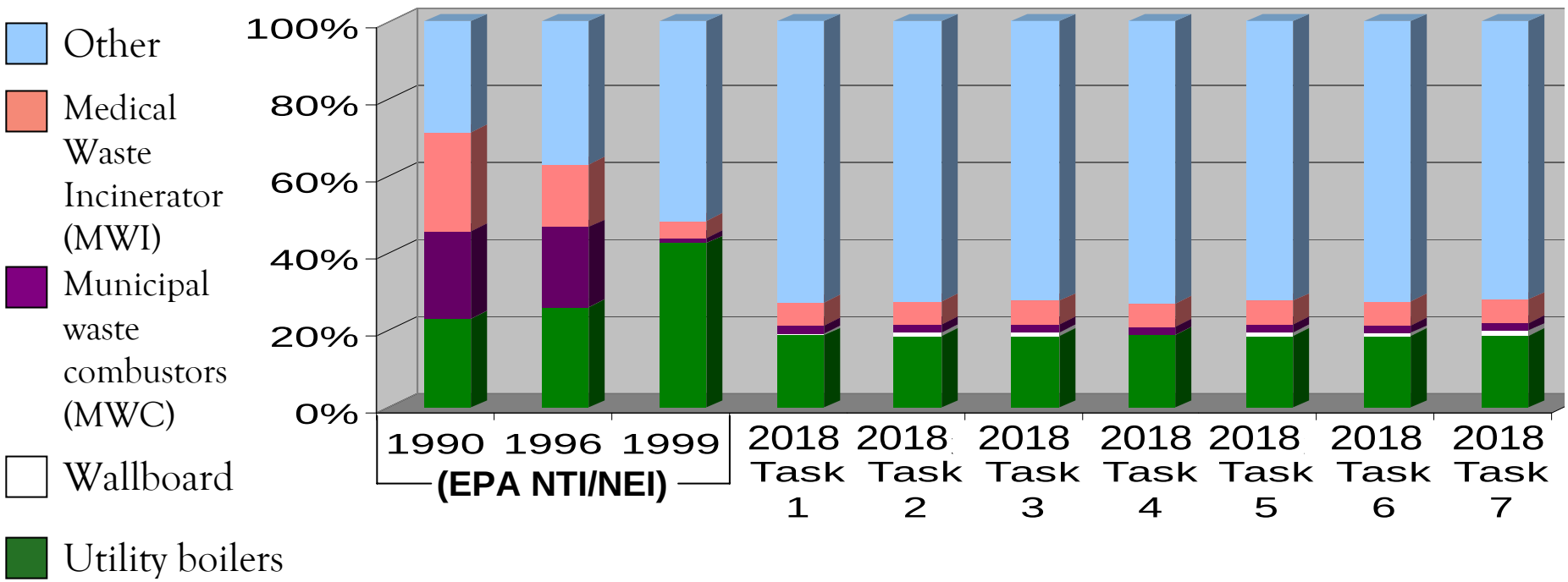
Wallboard Industry Estimates based on USG/DOE Study

Mercury emitted per dry gypsum processed	times	Industry use[#]	Potential Estimated Emissions Wallboard Industry Total
Task 1: 0.045 grams/ton	*	7,579,187 tons	750 pounds
Task 2: 0.08 grams/ton	*	7,579,187 tons	1300 pounds
Task 3: 0.09 grams/ton	*	7,579,187 tons	1500 pounds
Task 4: 0.01 grams/ton	*	7,579,187 tons	150 pounds
Task 5: 0.09 grams/ton	*	7,579,187 tons	1500 pounds
Task 6: 0.06 grams/ton	*	7,579,187 tons	1000 pounds
Task 7: 0.13 grams/ton	*	7,579,187 tons	2200 pounds

[#] Based on ACAA 2006 Coal Combustion Product (CCP) Production and Use Survey 7,579,187 (Short Tons) Used in Wallboard Production

Percent of Total U.S. Human Caused Direct Mercury Emissions by Year by Industry – A Future Estimate

Year 2018 Assumptions: Utility boilers mass emissions are reduced to 15 tons
Other, MWI, MWC mass emissions remain the same



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TCLP Leachate Data Summary

Sample ID	Hg (µg/L)
Task 1	<0.25
Task 2	<0.25
Task 3	<0.25
Task 4	<0.25
Task 5	<0.25
Task 6	<0.25
Task 7	<0.50

Standard	Hg (µg/L)
Maximum Contaminant Level (MCL) – US Drinking water standards	2
Solid Waste: Toxicity (40 CFR 261.24)	200