REGULATION OF AGRICULTURAL OPERATIONS USING EMISSION FACTORS AND PROCESS WEIGHT TABLES

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Abstract

A problem exists in the determination of the allowable emission rate (AER) from agricultural facilities using process weight tables (PWT). SAPRAs are using different PWT models and the basis of these different models is unknown. A new PWT model is proposed based upon the NSPS allowable emission rate of a 1,000 MW coal-fired power plant. Calculated factors for cotton gins, based on the AER, derived from the new model correspond to EPA AP-42 emission factors based upon source sampling. If SAPRAs were to replace their current models with the new model, a uniform method would exist for determining allowable emission rates for agricultural facilities.

Introduction

The process of regulating air pollution associated with particulate emissions from cotton gins, grain elevators, and feed mills involves permitting, enforcement, and rule-making. This process is not uniform between states. Each State Air Pollution Regulatory Agency (SAPRA) approaches the rule-making associated with regulating particulate emissions from agricultural operations differently. Each SAPRA develops their own state implementation plan (SIP) which has to be approved by Federal EPA. The primary goal of the SAPRA is to utilizes the regulatory process to prevent air pollution and "protect the public". The regulation of air pollution is not limited to reducing source emission rates to levels that will prevent health problems (health effects). Regulation of air pollution must also protect the welfare by providing the enabling authority to reduce source emission rates to prevent nuisance violations. SAPRAs are obligated to regulate particulate and odor emission rates so as to allow the public downwind from the source "the normal use and enjoyment of animal life, vegetation, or property" (TNRCC, 1993). A violation of this criteria is a violation of the nuisance standard. Most violations associated with agricultural operations are nuisance violations.

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The rule-making process has an inherent economic consideration associated with responsible regulation of air pollution. The rules and regulations are the enabling authority for permitting and enforcement. If the rules are unrealistic and either cannot be met or require an investment in air pollution control equipment such that the effected industry can not comply without going-out-of-business, the rule will not be enforced and this industry will be unregulated or a perception will be promoted that this industry is regulated when in fact it is not and the industry will operate under a gray cloud of potentially devastating enforcement. Neither option is attractive from the SAPRA or industry view.

Some SAPRAs require dispersion modeling results to insure that a facility's permitted allowable emission rate will not result in exceedances of the NAAQS downwind off the property. Some SAPRAs are using the NAAQS as a property line emission limit and are attempting to determine the permit allowable emission rate from the dispersion modeling results. The EPA approved ISC model is the dispersion model of choice by most SAPRAs. Williams and Parnell (1996) were critical of the ISC model and the process used by SAPRAs to determine a facilities allowable emission rate.

The goal of this paper is to bring order out of chaos. A new process weight table (PWT) model is proposed for agricultural facilities that will allow for uniformity between states and between agricultural operations. This model was derived from the New Source Performance Standard (NSPS) (emission factor) for a 1,000 MW coal fired power plant. The emission from power plants are products of combustion--a health based concern. Particulate emissions from cotton gins, grain elevators, or feed mills are regulated based upon the nuisance standard. Hence, determination of allowable emission rates using the new PWT should be conservative.

With the present EPA review and updating of the NAAQS underway, there is a strong possibility that the criteria pollutant for particulate matter in the standard will be changed from PM10 to PM2.5 (Chow, 1995). Hughes and Wakelyn (1996) reported that approximately 40% of the total suspended particulate (TSP) concentrations of particulate emissions of a cotton gin is PM10 and less than 2.5% is PM2.5.

Permitting with Emission Factors and Process Weight Tables

The process of permitting a cotton gin in Texas requires that the permit engineer estimate the allowable emission rate. This emission rate will establish whether this facility is a major source (emits more than 100 tons per year). If the facility is classified as a major source, it will be required to pay Title V emission fees. If not, the allowable emission rate will be used by SAPRA enforcement personnel to establish compliance with state air pollution rules and regulations. A Texas cotton gin's allowable emission rate is the lower value of the emission rate calculated using emission factors or the process weight table limits (PWT). The allowable emission rate in pounds of particulate per hour (lbs/hr) using emission factors is the emission factor (pounds per bale) determined by engineering analysis of the proposed air pollution abatement system described in detail in the permit application multiplied times the processing rate (bales per hour). The EPA AP-42 (1988) emission factor for cotton gins is 2.24 pounds per bale (lbs/b) of total suspended particulate (TSP).The emission factor can be used to calculate an allowable emission rate with the following equation:

$$AER = EF \times PR \qquad \textbf{(Eq. 1)}$$

where

AER = allowable rate of emission in pounds per hour,
EF = emission factor in pounds per bale (cotton) or ton (grain or feed) processed, and
PR = processing rate in bales (cotton) or tons (grain or feed) per hour. (The units must be consistent.)

To illustrate the PWT calculation consider the following example: A 20 bale-per-hour (bph) gin that has an emission factor of 2.24 lbs/b and will process 20,000 bales per year. This 20 bph gin will have an allowable emission rate of 44.8 lbs/hr using the emission factor of 2.24 lbs/b. The permit engineer's approach will be to permit the gin based upon Best Available Control Technology (BACT) including the test of "Economic Reasonableness." Once this has been established we will consider the emission factor of 2.24 lbs/b or 44.8 lbs/hr provided this allowable emission rate does not exceed the PWT allowable emission rate. The PWT limit is referred to as Regulation I in Texas. The permit engineer is obligated to determine if this gin will meet Regulation I. The process weight tables used in the Texas model can be described by the following two equations:

$$AER = 3.12 \times P^{0.985} \text{ for } P < 20 \text{ tons per hour} \qquad \textbf{(Eq. 2)}$$

$$AER = 25.4 \times P^{0.287} \text{ for } P > 20 \text{ tons per hour} \qquad \textbf{(Eq. 3)}$$

where

AER = allowable rate of emission in pounds per hour (lbs/hr), and
P = process weight rate in tons/hr.

Stripper cotton will typically require 2200 pounds of seed cotton per 500 pound bale of lint. Hence, a 20 bph gin will be processing 44,000 lbs/hr (22 tons/hr) and will have an allowable emission rate of 61.7 pounds per hour (Eq. 2). Since this rate exceeds the rate determined using the 2.24 lbs/b emission factor, the gin may be permitted using the emission factor and the allowable emission rate is 44.8 lbs/hr. The annual emission rate will be 22.4 tons per year [(2.24 lbs/b * 20,000 b/yr)/2,000 lbs/t)]. It will not be a major source.

If the gin were rated at 40 bph and processed 40,000 bales per year, the allowable emission rate would be 75.2 lbs/hr from the Texas process weight table and 89.6 lbs/hr using an emission factor of 2.24 lbs per bale. In the latter example, the Texas permit engineer would be required to permit the gin based upon the process weight table limit which would reduce the allowable emission factor to 1.88 lbs/b. The annual emission rate will be 37.6 t/yr. This gin will not be a major source.

The example presented above is not meant to describe the entire process used by the permit engineers with the Texas Natural Resources Conservation Commission (TNRCC) which is the SAPRA for Texas. This example illustrates how the PWT is used in the permitting process.

Consider a grain elevator that has a leg that can move grain at a rate of 12,000 bushels per hour. The EPA AP-42 (1988) uncontrolled emission factor was 8.6 lbs/t. (EPA has recently distributed revised emission factors that potentially could replace the 8.6 lb/t emission factor (EPA, 1995). If the grain had a test weight of 60 pounds per bushel (lbs/bu), the elevator would have a processing rate of 360 t/hr. The allowable emission rate would be 3,096 pounds per hour based upon the uncontrolled emission factor of 8.6 lb/t (Eq. 1). The allowable emission rate using the Texas process weight table would be 138 lbs/hr. There is a large difference in allowing 3,096 lbs/hr versus 138 lbs/hr. The 138 lbs/hr is equivalent to an emission factor of 0.38 lbs/t. The point has been made (Parnell et al, 1994) that the AP-42 emission factors for uncontrolled grain elevators (8.6 lbs/t) and feed mills (9.8 lbs/t) are in error.

The PWT used by the SAPRA in Oklahoma is different. The following equations define the allowable emission rates utilizing the Oklahoma model process weight table:

$$AER = 4.10 \times P^{0.67} \text{ for } P < 30 \text{ tons per hour} \qquad \textbf{(Eq. 4)}$$

$$AER = 55.0 \times P^{0.11} - 40 \text{ for } P > 30 \text{ tons per hour} \qquad \textbf{(Eq. 5)}$$

where

AER = allowable rate of emission in pounds per hour (lbs/hr), and
P = process weight rate in tons/hr.

The 20 bph gin example would be allowed to emit 32.5 lbs/hr by the Oklahoma PWT which is less than the 44.8 lbs/hr using the AP-42 emission factor of 2.24 lbs/b and considerably less than the PWT allowable emission rate allowed in Texas of 61.7 lbs/hr. Hence, the Oklahoma permit engineer could limit this gin to an emission factor of 1.63 lbs/b corresponding to the allowable emission rate of 32.5 lbs/hr.

The 40 bph gin example would be allowed to emit 43.4 lbs/hr which would equate to an emission factor of 1.08 lbs/b which is less than half of the AP-42 emission factor of 2.24 lbs/b and approximately one-half of the Texas PWT allowable emission rate of 75.2 lbs/hr.

The grain elevator example illustrates a more dramatic difference in the PWT limits used by Texas and Oklahoma. The Oklahoma PWT allowable emission rate for an uncontrolled grain elevator handling 360 t/hr is 65 lbs/hr which is equivalent to 0.18 lbs/t compared to 138 lbs/hr and 0.38 lbs/t in Texas.

These differences in allowable emission rates determined by different PWT in different states invoke the following questions by SAPRA permit engineers:

- Where is the science and/or research basis for these different PWT limits? This basis can not be found in the literature!
- Why do we have different PWT limits in different states?
- Is the PWT limit a "better" method of establishing allowable emissions for agricultural operations than the emission factor method? With the obvious errors in the emission factors for grain elevators and feed mills, perhaps this method may be better but without a proper scientific basis for equations 2, 3, 4, and 5 and a common PWT among states, this argument would be difficult to defend.
- Are the PWT limits achievable for cotton gins, grain elevators and feed mills? If they are not achievable, then we have a rule that is unenforceable.

Permit engineers with the SAPRA for Texas recognized the AP-42 emission factor errors associated with grain handling and have been using an uncontrolled emission factor of 0.3 lbs/t for grain elevators without drying systems. This factor results in an allowable emission rate of 108 lbs/hr compared to a PWT allowable emission rate of 138 lbs/hr for the grain elevator example with the 12,000 bu/hr leg. It would seem that the Texas model (Equations 2 and 3) for PWT is workable whereas the Oklahoma model (equations 4 and 5) may be too limiting for agricultural operations.

Allowable Emissions

Why is it necessary to have a method of determining allowable emissions from cotton gins, feed mills and grain elevators? The answer is that every industry must be allowed to emit pollutants. If every industry were required to reduce their emission rate to zero, no industry would be able to operate. This issue is complicated in that emissions from agricultural operations are regulated based upon a nuisance standard. Enforcement of rules and regulations for industries that are potential violators of a nuisance standard is subjective. It is not possible to eliminate subjectivity from a potential nuisance violation decision but a specified allowable emission rate will reduce the subjectivity and provide design limits for the engineering of the air pollution abatement systems. The allowable emission rate should be a compromise between the cost of the abatement system and the effect of this emission rate on "the normal use and enjoyment of animal life, vegetation, or property" (TNRCC, 1993) in the judgement of the SAPRA.

Most nuisance violations are complaint driven. A level of pollutant emissions that requires an air pollution abatement system that considers economic reasonableness to attain compliance with the state's rules and regulations may vary. The public in 1995 is concerned about a clean environment and are more likely to complain if they perceive that an industry is in violation of SAPRA rules and regulations. Some SAPRA permit engineers will take into consideration proximity to populated areas, schools and retirement communities in determining allowable emissions. With urban encroachment into what once were rural areas, there is an increased likelihood of complaints. In response to complaints, SAPRA personnel must have a system that allows for industry to operate within limits. If there are no limits on allowable emissions, it is possible that the SAPRA can mandate more expensive controls until the industry is forced to go-out-of-business. It would seem logical to have a method to determine objectively whether an agricultural operation is in compliance with SAPRA rules and regulations i.e., emitting particulate at rates that are less than or equal to the allowable emission rates.

Confounding this problem is the fact that a determination of whether a facility is in violation of the nuisance standard is subjective if a permit allowable emission rate has not been established.

The process weight table method of determining allowable emissions is a questionable science in that the basis for these equations does not appear to exist in the literature. However, a number of states have adopted rules that require compliance with PWT including Texas.

If one were to compare the PWT allowable emission rate of a 1000 megawatt (MW) coal fired power plant based on the new source performance standard (NSPS) emission factor of 0.03 pounds of particulate per million Btu (thermal input), the discrepancy is significant. The following assumptions were used to calculate allowable emission rates from this example power plant:

- 30% thermal efficiency
- 10,000 Btu/lb coal

The NSPS of 0.03 lb/10^6 is equivalent to an allowable emission rate of 341 lbs/hr. The PWT allowable emission rates using the Texas and Oklahoma models are 156 and 70 lbs/hr, respectively. Power plants are not required to comply with PWT allowable emission rates. It would seem that if we are going to require cotton gins, feed mills and grain elevators to comply with PWT allowable emission rates, we should require other industries to comply as well. But to reduce the NSPS allowable particulate emission rate of power plants from 0.03 lbs/10^6 Btu to 0.014 or 0.006 lbs/10^6 Btu, respectively would be very expensive and would create a significant political response from the utility industry. Why is it correct to reduce allowable emission rates for agricultural processors based upon a questionable science when it is not acceptable to do so to large industries? This a question that should be addressed by agricultural engineers with a response that is not emotional but based on scientific and technical merit.

Consider replacing all of the PWT equations with the following:

$$AER = 7.5 \times P^{0.6} \qquad \textbf{(Eq. 6)}$$

where

AER = allowable emission rate in pounds per hour (lbs/hr), and
P = process weight rate in tons/hr.

Using this very simple equation, the allowable emission rates for the 1,000 MW power plant are:

337 lbs/hr (PWT) vs 341 lbs/hr (EF);
20 bph gin are 48 lbs/hr (PWT) vs 45 lbs/hr (EF);
40 bph gin are 73 lbs/hr (PWT) vs 90 lbs/hr)EF);
12,000 bu/hr grain elevator are 256 lbs/hr vs 3,096 lbs/hr (EF).

This proposal should seriously be considered. The PWT method of determining allowable emissions should be uniform between states and should uniformly apply to all agricultural facilities. Using this new model (Eq. 6) will allow states to determine allowable emission rates from all processing industries and a uniform method of determine whether a specific industry should be classified as a "major source" covered by Title V emission fees. It is conservative, requires larger industries to install more efficient and costly controls and more closely corresponds to allowable emission rates calculated from emission factors.

A Proposed New Model

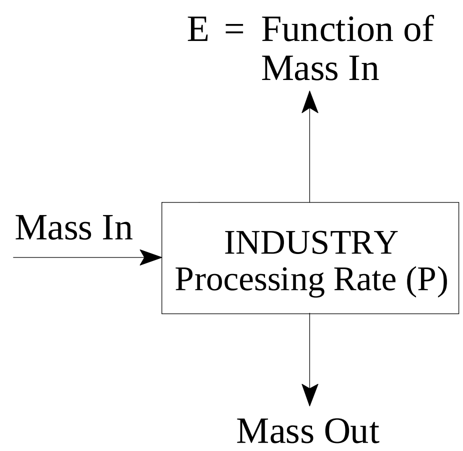
What should be the basis for a uniform PWT?
The PWT method for determining allowable emissions is based upon the concept of allowing a fraction of mass entering the process to be emitted. The general consensus is that the PWT model should be as follows:

$$AER = A\,P^{B} \qquad \textbf{(Eq. 7)}$$

where,

AER = allowable emission, lbs/hr;
P = processing weight, ton/hr; and
A and B = constants

One method of determining A and B is to establish a target. The NSPS for coal fired power plants is 0.03 lbs/10^6 Btu.



For a 1,000 MW power plant that is 30% efficient and burning coal with a heating value of 10,000 Btu/lb, the thermal input is 1.13 x 10^{10} Btu/hr, which yields an NSPS allowable emission rate of 341 lb/hr. The input rate of coal is 569 tons per hour. Given AER and P in Equation 7, one can calculate A and B by trial and error. A = 7.5 and B = 0.6 (Eq. 6).

This concept of developing a uniform equation for the PWT limit of allowable emission is based upon the following:

1) The model for PWT allowable emission limits is $AER = AP^B$.

2) The basis for determining A and B is a 1,000 MW coal fired power plant with a thermal efficiency of 30%, (10,000 Btu/lb Coal and the NSPS of 0.03 lbs/10^6 Btu (TI).

Tables 1 through 7 illustrate that this new PWT model can work for cotton gins, grain elevators, feed mills and power plants. There could be some criticism in that an equivalent emission factor for small cotton gins, grain elevators and feed mills is higher than might be expected. It is assumed by the authors that the allowable emission rate will be determined by using the lower value of allowable emissions determined by the emission factor method (Eq. 1) or PWT method. Hence, the emission factor method will be the procedure that will be used by SAPRA engineers for small plants.

Tables 6 and 7 illustrate the collection efficiencies associated with the emission factors listed in Tables 4 and 5. It should be noted that the efficiencies required of agricultural facilities are very high when one considers that these facilities are not using electrostatic precipitators (ESP) used in power plants. Most agricultural facilities utilize inertial separation (cyclones) for air pollution abatement. Many SAPRA engineers would not expect cyclones to achieve collection efficiencies of 98% and higher. In reality, cyclones used in cotton gins are achieving these levels of control.

This proposed concept of using one PWT equation (Eq. 6) to determine an allowable emission rate for all agricultural industries for all processing rates in all states has merit. Cotton gins, grain elevators and feed mills will be regulated on similar allowable emission rates based upon throughput.

Summary and Conclusion

Agricultural processing facilities such as grain elevators, feed mills and cotton gins are being regulated using emission factors and process weight tables. The regulation process includes a determination of the permitted allowable emission rate. Any agricultural facility that is emitting particulate at a rate less than their permit allowable is in compliance with their SAPRA rules and regulations. It would seem logical that the determination of the permit allowable emission rate should be uniform across state lines. *It is not!*

Many states use different PWT models to determine the permit allowable emission rates. The scientific basis for these different PWT models is questionable. A simple new model was proposed that could be used to determine permit allowable emission rates for power plants, cotton gins, feed mills and grain elevators. The basis for this model was the NSPS for a 1,000 MW power plant, with a thermal efficiency of 30%, using coal, having an energy content of 10,000 Btu/lb. The use of this new model would result in a uniform application of the PWT method for determining permit allowable emission rates.

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Table 1. PWT models[1] used by Texas, Oklahoma and California (EPA), and the proposed new model.

Texas	$AER^* = 3.12\ P^{0.985}$	P** <20 tons/hour
	$AER = 25.4\ P^{0.287}$	P>20 tons/hour
Oklahoma	$AER = 4.1\ P^{0.67}$	P<30 tons/hour
	$AER = 55\ P^{0.11} - 40$	P>30 tons/hour
California (EPA	$AER = 3.59\ P^{0.62}$	P<30 tons/hour
	$AER = 17.31\ P^{0.16}$	P>30 tons/hour
New Model	$AER = 7.5\ P^{0.60}$	

* AER = Allowable emission rate in pounds per hour

** P = Processing rate in tons per hour

[1] This Oklahoma model is also used in North Carolina, South Carolina, Alabama, Mississippi, and Tennessee. The EPA model is used by California, but is modified in that more than one process stream can be defined for each gin. Georgia also allows for more than one process stream for each gin, but uses another model, i.e. $AER = 7\ B^{0.5}$, where B equals the bales per hour. Most state use 1,500 pounds per bale for picked cotton. North Carolina uses 1,400 pounds per bale for picked cotton.

Table 2. Comparison of allowable emission rates of particulate using the Texas, Oklahoma, California (EPA) and Proposed New Models.

		Processing Rate (tons/hr)	Texas (lbs/hr)	Oklahoma (lbs/hr)	EPA (lbs/hr)	Proposed New Model (lbs/hr)
Stripper Gins	10 bph	11	33	20	16	32
(2200 lbs/bale)	20 bph	22	62	33	24	48
	40 bph	44	75	43	32	73
Picker Gins	10 bph	7.5	23	16	13	25
(1500 lbs/bale)	20 bph	15	45	25	19	38
	40 bph	30	67	40	30	58
Grain Elevators	5,000 buph*	150	107	55	39	152
(60 lbs/bushel)	10,000 buph	300	131	63	43	230
	30,000 buph	900	179	76	51	444
Feed Mills	5 tons/hr	5	15	12	10	20
	10 tons/hr	10	30	19	15	30
	15 tons/hr	15	45	25	19	38
	20 tons/hr	20	60	31	23	45

*buph = bushels per hour

Table 3. Emission Factors (pounds per bale) for stripper and picker cotton gins and emission factos (pounds per ton) for grain elevators and feed mills using the allowable emission rates calculated using the Texas, Oklahoma, California (EPA) and Proposed New Model for PWT limits (Table 2).

		Texas	Oklahoma	EPA	Proposed New Model
Stripper Gins	10 bph	3.30 lbs/b	2.04 lbs/b	1.59 lbs/b	3.16 lbs/b
(2200 lbs/bale)	20 bph	3.08 lbs/b	1.62 lbs/b	1.22 lbs/b	2.40 lbs/b
	40 bph	1.88 lbs/b	1.10 lbs/b	0.79 lbs/b	1.81 lbs/b
Picker Gins	10 bph	2.27 lbs/b	1.58 lbs/b	1.25 lbs/b	2.51 lbs/b
(1500 lbs/bale)	20 bph	2.25 lbs/b	1.26 lbs/b	0.96 lbs/b	1.90 lbs/b
	40 bph	1.69 lbs/b	1.33 lbs/b	0.74 lbs/b	1.44 lbs/b
Grain Elevators	5,000 buph	0.71 lbs/t	0.37 lbs/t	0.26 lbs/t	1.01 lbs/t
(60 lbs/bushel)	10,000 buph	0.44 lbs/t	0.21 lbs/t	0.14 lbs/t	0.77 lbs/t
	30,000 buph	0.20 lbs/t	.08 lbs/t	0.06 lbs/t	0.49 lbs/t
Feed Mills	5 tons/hr	3.04 lbs/t	2.4 lbs/t	1.95 lbs/t	3.94 lbs/t
	10 tons/hr	3.01 lbs/t	1.9 lbs/t	1.50 lbs/t	2.99 lbs/t
	15 tons/hr	3.00 lbs/t	1.68 lbs/t	1.28 lbs/t	2.54 lbs/t
	20 tons/hr	2.98 lbs/t	1.53 lbs/t	1.15 lbs/t	2.26 lbs/t

Table 4. Allowable Emission rates (pounds per hour) utilizing the Texas, Oklahoma, California (EPA) and Proposed New Model for calculating PWT Limits for coal fired power plants. The power plant was assumed to have a thermal efficiency of 30%.

	Processin g Rate (tons/hr)	Texas (lbs/hr)	Oklahoma (lbs/hr)	EPA (lbs/hr)	Proposed New Model (lbs/hr)
10,000 Btu/lb Coal					
100 MW	56.9	81	46	33	85
500 MW	284	129	62	43	222
1,000 MW	569	157	71	48	337
5,000 Btu/lb Coal					
100 MW	113.7	99	53	37	129
500 MW	569	157	71	48	337
1,000 MW	1137	191	79	53	511

Table 5. Emission Factors in pounds of particulate per milllion Btu's thermal input associated with the allowable emission rates utilizing the Texas, Oklahoma, California (EPA) and Proposed New Model for PWT limits (Table 4).

	Texas ($lbs/10^6$ Btu's)	Oklahoma ($lbs/10^6$ Btu's)	EPA ($lbs/10^6$ Btu's)	Proposed New Model ($lbs/10^6$ Btu's)
10,000 Btu/lb Coal				
100 MW	0.071	0.040	0.029	0.075
500 MW	0.023	0.011	0.008	0.039
1,000 MW	0.014	0.006	0.004	0.030
5,000 Btu/lb Coal				
100 MW	0.087	0.047	0.033	0.113
500 MW	0.028	0.013	0.008	0.059
1,000 MW	0.017	0.007	0.005	0.045

Table 6. Air pollution abatement efficiencies (penetrations) required to meet PWT allowable emission.

		Texas (%)		Oklahoma (%)		EPA (%)		Proposed New Model (%)	
		η	P_t	η	P_t	η	P_t	η	P_t
Stripper Gins*	10 bph	99.587	.413	99.75	.250	99.80	.20	99.60	.40
(2200 lbs/bale)	20 bph	99.612	.388	99.794	.206	99.85	.15	99.70	.30
	40 bph	99.766	.234	99.866	.134	99.90	.10	99.77	.23
Picker Gins**	10 bph	98.47	1.53	98.93	1.07	99.13	.87	98.33	1.67
(1500 lbs/bale)	20 bph	98.50	1.50	99.17	.83	99.37	.63	98.73	1.27
	40 bph	98.88	1.12	99.33	.67	99.50	.50	99.03	.97

η = efficiency
P_t = penetration
* Stripper gins have 800 pounds of trash and fine dust per bale;
** Picker gins have 150 pounds of trash and fine dust per bale.

Table 7. Air pollution abatement efficiencies (penetrations) required to meet PWT allowable emissions.

	Texas (%)		Oklahoma (%)		EPA (%)		Proposed New Model (%)	
10,000 Btu/lb								
Coal	98.98	1.02	99.42	0.58	99.59	0.41	98.93	1.07
100 MW	99.68	0.32	99.84	0.16	99.89	0.108	99.44	0.558
500 MW	99.80	0.20	99.91	0.089	99.94	0.06	99.58	0.423
1,000 MW								

* Coal with 10% Ash assumed that 30% of the Ash falls out as Bottom Ash in the furnace.