CHARACTERIZATION OF COTTON GIN PM_{2.5} EMISSIONS BASED ON EPA STACK SAMPLING METHODOLOGIES AND PARTICLE SIZE DISTRIBUTIONS Michael D. Buser Oklahoma State University Biosystems and Agricultural Engineering Stillwater, OK Derek P. Whitelock USDA-ARS Southwestern Cotton Ginning Research Laboratory Mesilla Park, NM J. Clif Boykin USDA-ARS Cotton Ginning Research Unit Stoneville, MS Greg A. Holt USDA-ARS Cotton Production and Processing Research Unit Lubbock, TX

<u>Abstract</u>

A project to characterize cotton gin emissions in terms of stack sampling was conducted during the 2008 through 2011 ginning seasons. The impetus behind the project was the 2006 EPA implementation of a more stringent standard for particulate matter less than or equal to 2.5 μ m (PM_{2.5}) and the fact that there was very little available cotton gin PM_{2.5} emissions data. Currently, there are no EPA AP-42 PM_{2.5} emission factors for cotton gins. In 2007, when this project was being developed California was estimating that PM_{2.5} emission factors were 36% of the total particulate emission factors. This estimate was to be used as a place holder until actual data became available. The objective for this study was to collect PM_{25} emission factor data for cotton gin systems in regions across the cotton belt based on the EPA approved stack sampling methodology Other Test Method 27 and a method that uses Method 17 concentrations multiplied by the percent less than 2.5 microns determined by the particle size analysis of the Method 17 filter and wash retrieved from each run. Emission factors were developed for 17 different ginning systems including: unloading, 1st stage seed-cotton cleaning, 2nd stage seed-cotton cleaning, 3rd stage seed-cotton cleaning, overflow, 1st stage lint cleaning, 2nd stage lint cleaning, combined lint cleaning, cyclone robber, 1st stage mote, 2nd stage mote, combined mote, mote cyclone robber, mote cleaner, mote trash, battery condenser and master trash. Results showed large discrepancies between the two methods (Figure 1). These discrepancies were attributed to the cotton fibers and large particles in the exhaust stream impacting the performance of the PM_{2.5} sizing cyclone. Combining the measured emission factors for systems that represent a typical gin in AP-42 (Table 1), the typical AP-42 gin PM_{2.5} emission factor based on EPA approved methodologies was 0.148 lb/bale; about 83% lower than the 2007 California estimate of 0.861 lb/bale. In Table 2 the $PM_{2.5}$ emission factors based multiplying the Method 17 concentrations by the percent less than 2.5 microns obtained from the particle size analysis was compared to emission factors obtained from OTM27 for a typical gin. The Method 17 and particle size analysis $PM_{2.5}$ emission factor for a typical gin was 0.044 lb/bale; about 70% less than the emission factor determined from OTM27 and about 95% lower than the California emission factor estimates. These substantial differences were attributed to the cotton fiber and larger particles impacting the PM2.5 sizing cyclone. Additional information can be found in technical reports at http://buser.bioen.okstate.edu/air-quality/national-cotton-gin-technical-reports.



Figure 1. Average measured $PM_{2.5}$ emission factors from EPA Method 17 multiplied by the percent less than 2.5 microns from the particle size analysis and EPA OTM27.

Table 1. Average measured $PM_{2.5}$ emission factors from EPA approved stack sampling methodologies compared and merged with EPA AP-42 emission factors.

	Unloading	1 st SCC	2 nd SCC	Combo LC	Combo Mote	Batt Cond	Master Trash	Overflow	AP-42 Typical Gin
Test	0.049	0.018	0.008	0.030	0.016	0.008	0.009	0.009	0.148
No. of Tests	3	7	5	7	7	6	5	3	
CA Initial Est. 36% of Total	0.103	0.129	0.087	0.210	0.100	0.014	0.193	0.026	0.861
Diff from CA Initial Est.	-52%	-86%	-91%	-86%	-84%	-43%	-95%	-66%	-83%

Table 2. Average and comparison of $PM_{2.5}$ emission factors from EPA approved stack sampling methodologies, Method 17 concentrations multiplied by the percent less than 2.5 microns from the particle size analysis, and EPA AP-42 emission factors.

PM _{2.5}	PSD	Unloading 0.015	1st SCC 0.010	2nd SCC 0.003	Combo LC 0.005	Combo Mote 0.003	Batt Cond 0.001	Master Trash 0.006	Overflow 0.001	AP-42 Typical Gin 0.044
	Test	0.049	0.018	0.008	0.030	0.016	0.008	0.009	0.009	0.148
CA Initial Est 36% of Total		0.103	0.129	0.087	0.210	0.100	0.014	0.193	0.026	0.861
Diffe	rence									
PSD	- Test	-69%	-46%	-67%	-82%	-81%	-89%	-36%	-87%	-70%
PSI	D-CA	-85%	-92%	-97%	-98%	-97%	-93%	-97%	-96%	-95%