CONSIDERATIONS FOR AN APPROPRIATE AIR QUALITY PERMIT FOR COTTON GINS

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Introduction

In 1990, Congress amended the Clean Air Act (CAA). Part of the amended Act were new requirements for federal operating permits (Title V) for attainment of particulate matter (PM) ambient air standards and for hazardous air pollutants (HAP) standards (Wakelyn, 1999). During the 1990/91 ginning season, there were 1,533 active cotton gins operating across the cotton belt that processed an average of 9,810 bales each on an approximately 15,000,000 bale crop (Glade et al., 1991). Research has shown that cotton gins are not significant sources of HAP as defined under the amended CAA (Hughs et al., 1997a, Hughs et al., 1997b). However, cotton gins are sources of PM which is the only pollutant of concern for gins under the CAA (Hughs and Wakelyn, 1997).

Since the passing and implementation of the amended CAA by the federal EPA in 1990, most states have finalized their state implementation plans (SIP). Also, most Cotton Belt states/air districts have final approval of their federal operating permit program (Title V) (Wakelyn, 1999). In the intervening period since 1990, the National Cotton Council (NCC), the National Cotton Ginners Association (NCGA), state ginning associations, and the USDA, ARS, ginning laboratories have worked and continue to work with the Federal Environmental Protection Agency (EPA) and state environmental agencies to develop acceptable permitting requirements for cotton gins. During the time that the NCC and others have been working with various state environmental agencies in developing acceptable permitting requirements, the number of operating cotton gins in the U. S. has significantly decreased. For the 2000/01 ginning season, there were 1,009 operating cotton gins in the U. S. to process a crop of roughly 16,000,000 bales. This gives a current average of approximately 15,857 bales per gin across the cotton belt.

The 2000/01 cotton crop is approximately the same size as 10 years ago, however, it is being processed with significantly fewer gins than were in operation in 1990. Numbers of gins will probably continue to decline somewhat as older and smaller plants are combined into fewer new and larger capacity gin plants. This activity is occurring all across the cotton belt. These new plants must be permitted for operation depending on the regulations of the particular state/air district where the affected gin is located. Also, the permitting of existing gins is still ongoing in many parts of the cotton belt. Currently, the permitting requirements and the difficulties of obtaining operating air permits for gins vary widely between states/air districts. Some gin building projects have been canceled and others have been moved across state lines because of the variability and difficulty of air permitting requirements. This paper is an attempt to address the issue of permitting gins in a more uniform fashion across the cotton belt.

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Background

Cotton ginning occurs in 17 states across the southern tier of the U. S. These states can be divided into four major regions as follows:

Southeast–Virginia, North Carolina, South Carolina, Georgia, Alabama, and Florida
Mid-South–Missouri, Tennessee, Mississippi, Arkansas, and Louisiana
Southwest–Texas, Oklahoma, and Kansas
West–New Mexico, Arizona, and California

Table 1 shows the number of gins in each region in 1990 and in 2000. The Southeast region has remained static overall in terms of numbers of operating cotton gins, but all other regions have had very significant decreases in gin numbers. Because of the boll weevil eradication program and other factors, cotton production has actually increased in the Southeast in the past 10 years. Other regions, particularly the West, have suffered some declines in some states in overall cotton production during the same time.

Overall, the U. S. cotton industry has not remained static but production has made significant shifts over the past decade and those shifts are still continuing into the future. Whatever the cotton production, all of the cotton crop must be ginned every year. The ginning industry has responded by building new gins and consolidating others as necessary to meet the demand. This has led to a very dynamic situation as far as regulating and permitting is concerned. (A few states, such as California and Texas, have been permitting cotton gins for a long time. They have developed a system and working relationships between the state cotton industry and the state regulatory agencies. Other states, as indicated earlier, are currently in the process of developing their gin permitting procedures.)

All U.S. cotton in commercial production is now harvested by machines of two types, picking and stripping. Machine-stripping has historically been confined to the Southwest region and accounts for 20 to 30% of average U.S. production. However, with the advent of ultra-narrow-row (UNR) cotton production, finger-type strippers are being used to some extent in other traditionally picker harvested areas. The difference between the two harvest methods as related to air operating permits is the amount of trash that must be handled during ginning. A stripper gin may handle five or six times more trash than a gin handling machine-picked cotton.

Federal Guidance

Source permitting issues for cotton gins center around the amount of particulate being emitted. In general, cotton gins are minor sources of PM of which PM10 (particulate whose aerodynamic diameter is less than or equal to 10 microns) is the PM of concern. A minor source is any source that emits less than 100 tons per year (tpy) in an attainment area, or 70 tpy in a non-attainment area, of PM10 (Wakelyn, 1991). Depending on its particulate emission controls, a gin would have to process a minimum of over 160,000 bales in an attainment area, or 115,000 bales in a non-attainment area, to qualify as a major source for PM10 (EPA, 1996). These ginning volumes are calculated from EPA published average emission factors developed from source test data on cotton gins controlled with high-efficiency cyclones (EPA, 1996).

Further guidance for states to address the minor source status of cotton gins was issued by EPA in 1998 (Wakelyn, 1999, Seitz and Schaeffer, 1998). Many CAA requirements apply only to major sources with a potential to emit air pollutants at levels greater than a given amount. The EPA, in its current regulations, defines a source's potential to emit (PTA) air pollutants as follows:

> "Potential to emit" is the maximum capacity of a stationary source to emit under its physical and operational design. Any physical or operational limitation on the source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation, or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the (EPA) Administrator.

Table 2 gives the PTE production guidance for cotton gins as issued by EPA. The EPA calculated the cutoffs based upon the upper end of the range of available source tests that were documented and used in AP-42. EPA believes these numbers given in Table 2 are very conservative (worse than the typical "worst-case") and should ensure that there is a very low probability that a cotton gin limited to these levels would not have any potential to emit major amounts of PM10. The PTE guidance document also stated that, "state and local prohibitory rules and general permits must require records sufficient to ensure that the cutoff can be enforced". Prohibitory rule in this case is a term similar to other terms such as "general permits", "exclusionary rules", and "permits-by-rule" that are used by regulatory agencies.

The numbers in parenthesis in the third column of Table 2 were calculated using the average values from AP-42 (EPA, 1996) and illustrate how conservative the EPA guidance document is. For example, the EPA guidance from Table 2 for a cotton gin with cyclones on all exhausts under a major cutoff of 100 tpy PM10 would be allowed to process up to 90,000 bales and still remain a minor source of PM10. However, that same gin, using the AP-42 emission factor for PM10, would be allowed up to 243,900 bales before being considered a major source of PM10.

The EPA described two overall approaches that states and local agencies can use to establish enforceable emission limits which ensure that a source's potential emissions are below the major source threshold. The first approach would be case-by-case permitting. Under this approach, agencies create terms and conditions tailored for a specific plant site. This approach is essential for complex sources that comprise many different pollutant sources and source types and sources that limit their emissions to near-major source levels (Seitz and Schaeffer, 1998).

The second approach, which is appropriate for less complex sources such as cotton gins, has states and local agencies creating a standard set of terms and conditions for many similar sources at the same time. If this approach were to be used for cotton gins, the permitting agency would then incorporate these standard set of terms and conditions into a general permit for gins under their jurisdiction. Gins wishing to be subject to the general permit would provide a notification to the permitting agency, and then must comply with the standard terms and conditions. From the gin's perspective, the administrative procedure for receiving a general permit is typically much more streamlined than receiving a case-by-case permit. State "prohibitory rules" are similar to general permits, but states or local agencies put them in place with a regulation development process rather than a permitting process.

The EPA issued the guidance summarized in Table 2 to assist states/regions in efficiently creating potential-to-emit limits for small sources, help reduce uncertainty of small business owners of their minor source status, and to help foster technical consistency among permitting agencies. The EPA also stated in their guidance document that the screening cutoff levels in Table 2 are not the only limitations that would be appropriate for a given type of source, nor are they the only values that EPA would find acceptable. However, the clear signal has been given that as long as a particular cotton gin meets the conditions given in Table 2, and has no unusual circumstances, it can very conservatively and very safely be considered a minor source for PM10 as far as the EPA is concerned. This does not mean that cotton gins with higher ginning volumes than those given by EPA in Table 2 could not be minor sources of PM10. It does mean that the majority of cotton gins in the U. S. could easily be classified as minor sources of PM10 as the U. S. average yearly ginning volume for 2000 is approximately 15,857 bales.

Regulating Cotton Gin Air Pollution

Methods of permitting cotton gins and verifying emission rates are not uniform across the cotton belt (Parnell and Wakelyn, 1996). Each state's goal in regulating PM is to prevent or lower air pollution as outlined in their SIP. Two unsatisfactory methods that have been used of insuring that a facility's permitted allowable emission rate will not exceed permitted limits are dispersion modeling and process weight limits. Industry experience has shown that neither of these methods work for permitting cotton gins. Dispersion modeling is generally done with the EPA recommended Industrial Source Complex (ISC) models. Zwicke et al. (1999) have stated that the ISC models are inaccurate. The ISC models were originally developed for industries that had single, several hundred feet tall, large diameter stacks such as power plants and smelters. They are poorly adapted to gin facilities that have multiple, short, small diameter stacks. ISC model results, when applied to cotton gins, give very inaccurate and conservative results. This inaccuracy could easily result in a cotton gin incorrectly being deemed out of compliance with emission standards (Zwicke et al., 1999). Use of the ISC models to verify emission levels are part of several cotton belt SIPs. The problems in application to cotton gins are recognized by some state agencies, and other avenues are usually used to verify gin particulate emission levels. Most state agencies have not recognized this problem, which puts agricultural sources in a very difficult position.

Process weight emission rate limits are included in the emission control regulations of at least eleven cotton growing states (Wilmot et al., 1974). The form of most of the process weight rate limits for the various states is an equation that calculates an allowable emission rate in pounds based on a total weight in tons of material processed per hour. The coefficients of the equations used are not the same for all states. In general, however, the allowable emission rates for processing rates varying from 0.5 to 3,000 tons per hour go from a low of 1.6 pounds/hour (0.5 ton processing rate in Alabama, Tennessee, and Texas) to a maximum of 876 pounds/hour (3,000 ton processing rate in Mississippi). The usual maximum allowable emission rate is approximately from 60 to 90 pounds per hour. The practical effect of using the existing process weight rate equations to regulate gin emissions is that the rates are so low that a gin must be broken into processing streams and the process weight method applied to the individual streams, in order to meet required levels. Also, the use of existing process rate equations to determine allowable emissions is questionable science as any basis for these equations does not appear to exist in the literature (Parnell and Wakelyn, 1996). As the numbers of cotton gins has decreased, their hourly processing rates have increased making them even less likely to be able to meet allowable emission rates based on any process weight equations or tables.

A more applicable method for regulating gin particulate emissions is by opacity. Opacity is an indicator of the amount of visible light in percent that is blocked by a plume. There is some scientific basis for this standard as it was developed from the Ringlemann scale which compared the shade of gray of smoke emissions with that of a chart (Beutner, 1974). The original Ringlemann scale was useful only for black smoke emissions. The method has been adapted and today, opacity readers are trained to judge the equivalent opacity of emissions of any color. The EPA and many states have adopted this method for regulating particulate emissions (EPA Method 9, 1994a). The results of opacity are dependent on the position of the sun relative to the observer, and errors can be made on overcast days.

Obviously, no observations can be made at night. Also, at lover opacity numbers (10 to 20%), human errors greatly increase. Opacity has the advantage in that it is relatively quick and easy to read. For this reason, it is often used as an indicator of compliance with a permitting agreement.

Research has shown that opacity cannot currently be used as an indication of gin particulate emission rates in place of stack sampling (Hughs and Wakelyn, 1997). Opacity can only be used to determine dust loading if the particle size distribution and refractive index are known and constant. Both particle size distribution and refractive index of the particulate being emitted from gin exhausts across the cotton belt are highly variable and generally unknown. Even though opacity generally increases as TSP concentrations increase, opacity is currently not useful as a means of determining absolute levels of particulate being emitted from cotton gins.

Stack sampling is the most direct method of determining particulate emission levels and size distributions. There are several approved methods of stack sampling, but they are all related to what is called a Method 5 sampler (EPA, 1994b). This method uses an isokinetic sampling procedure to sample an exhaust. It was originally developed for large diameter stacks but is adaptable to the small diameter cyclone exhausts used at cotton gins. This method is now being used in some areas as a primary means to determine emission levels. Its drawbacks are that it is expensive and time consuming to run the procedure and to do the necessary laboratory analysis and reporting required to make an emission level determination. Several weeks are required to do a complete cycle of data collection and reporting for a given cotton gin exhaust.

Method 5 sampling procedures have been used to collect a considerable amount of emissions data from cotton gins in the western region. A lot of this information has been analyzed and used to develop the current AP-42 emission factors for cotton gins (EPA, 1996). The emission factors contained in AP-42 have a scientific basis and have been used by some states/air districts as part of the gin permitting process. The California Cotton Ginners Association (CCGA) supplied a significant amount of the data used to develop the current AP-42 emission factors. This data was taken as part of the permitting process used by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) which contains most of the operating cotton gins in California. The CCGA has continued to compile source test data as emission source tests were done to prove permit compliance in the SJVUAPCD. This data has been made available in the CCGA Cotton Gin Emission Factor Handbook to regulators for the SJVUAPCD (CCGA, 2000). The goal of the CCGA was to minimize and reduce the number of source tests performed on cotton gins. This additional data is in close agreement with the information already contained in AP-42. This data scientifically supports the premise that any well controlled cotton gin is a minor source of PM10 unless it is processing well over 100,000 bales per year.

General Cotton Gin Permitting Rules

The cotton ginning industry has now had many years experience in developing, measuring, and monitoring cotton gin emission controls. The primary control device has been and remains the high efficiency cyclone. The performance of a properly designed cyclone on particulate emission abatement from cotton gins has been well and scientifically documented. This background has resulted in the EPA issuing a very conservative opinion that, at the very minimum, any reasonably controlled cotton gin processing 50,000 bales or less anywhere in the U. S. is a minor source of PM10 (Table 2). Data collected by the EPA and the ginning industry and published as AP-42 emission factors would support the contention that, at a minimum, any gin processing 116,000 bales or less in the U.S. is a minor source of PM10 (Table 2). This type of assurance should enable any cotton belt state/air district to make its gin permitting process more uniform with other cotton belt state/air districts and more streamlined with reasonable confidence of fulfilling its emission control mandate.

The purpose of any uniform gin permitting rule would be to limit the discharge of particulate matter from any ginning operation by establishing emission and control standards. The rule could be made applicable to any new, existing, or modified cotton ginning plant. A cotton gin plant would be defined as a facility whose primary function was to remove the fiber from the seed and then clean and bale the ginned fiber. Emission controls for the gin plant would be defined as part of the operating permit. The primary controls for the ginning plant would be the high efficiency cyclone. A high efficiency cyclone could be defined as either of a 2D2D or a 1D3D configuration.

A uniform permit would have certain standards and limitations that would be a federally enforceable part of the permit. Each gin plant could be limited in its discharge into the ambient air any air contaminant, other than water, in excess of 20 percent opacity. This opacity limitation is in line with current limits in many states. Also, the controls on each gin emission point would be specified as part of the permit. For example, all systems that handle seed cotton would be a minimum of high efficiency cyclones or equivalent devices. Controls on all lint handling systems could be cyclones or equivalent devices on new or modified plants. Existing gin plant lint handling systems could be grandfathered in with existing controls if those controls were a minimum of screen baskets or fine mesh screens on condenser drums. If there was a local concern of excessive particulate emissions from lint systems utilizing screen baskets or fine mesh screens, high efficiency cyclones or the equivalent could be phased in over a specified time frame of several years. The phase in of lint system controls over an extended period would be important to avoid undue economic hardship to small existing gin plants.

The design and performance of all gin air handling system emission controls could also be part of the uniform permit. AP-42 (EPA, 1996) gives an estimate of the average expected emission factors of gin plants with specified controls. This information, can be used to establish the source category of any gin plant depending on its yearly expected and/or its permitted annual production. In addition, the performance and design parameters of various high efficiency cyclone designs have been well established by research (Green et al., 2000, Gillum and Hughs, 1983). Cyclones maintain their high collection efficiency over a wide range of air flows. A uniform permit could specify ideal air flow rate for a given cyclone design as well as a permissible operating range. As part of its operating permit, each gin plant could have the baseline operating air flow rate and other parameters, such as total system pressure drop, of each emission point documented by an approved measurement method (EPA, 1994c). Once the air system operating parameters were established, no further measurements would need to be made, unless mechanical alterations were made to the system, or there was some other reason to believe that the system operation had changed. Any control system whose air flow rate was outside the allowed range would then have a specified time to bring that system within range.

An additional part of the gin operating permit could be an operating maintenance plan that is submitted by each gin to the responsible regulatory agency. The plan would include certain periodic checks of the emission control systems operation, such as periodic system static pressure measurements referenced back to the baseline measurements, and visual checks for leaks and/or excessive visible emissions. These periodic checks would be documented as part of the gin plant's approved operating maintenance plan.

As a final part of the operating permit, the permitting regulatory agency could reserve the right to verify a specific gin plant's emissions compliance by source testing one or more gin emission points (EPA, 1994b). Ideally, the gin's compliance determination would be referenced to AP-42 by the concerned regulatory agency (EPA, 1996). Using source testing as a means of compliance, determination would likely only be required by a specific complaint or other circumstance outside of the normal expected design and day-to-day gin operation of the gin plant.

The uniform gin permitting rule that is generally outlined above would not include either a process weight or a modeling requirement as part of the gin operating permit. It does include provisions that are part of the permit and are federally enforceable to assure particulate emissions compliance. It would simplify and streamline the gin permitting process in many parts of the cotton belt.

Summary

The above discussion is an attempt to raise issues and suggest possible means to address the permitting of cotton gins based on sound science. This discussion is probably only going to have application in those states/regions where methods of permitting cotton gins are still being developed. A very brief example of what a possible general operating permit might include was given as a starting reference. In addition to the emission factors as published in AP-42 (EPA, 1996), other methods that are used by the various states in their efforts to implement safeguards and compliance verification tools into their permits were also given. The pros and cons of these additional methods have been discussed. It should also be pointed out that the application of these additional methods varies from agency to agency. It is up to the individual state/region and their own regulated ginning industry to determine which of these additional tools, if any, are most useful for their particular regulatory situation. The goal still remains to make the permitting of cotton gins be based on sound science, more streamlined and more uniform across the U. S. cotton belt, and to remove some of the current uncertainty as to the status of individual cotton gins within the regulatory framework.

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Table 1.

Number of Gins by Region and Years

Region	1990	2000
Southeast	210	209
Mid-South	512	316
Southwest	557	359
West	254	125
Gin Totals	1533	1009

Table 2. PTE Guidance for cotton gins.

For cotton gins with the following configuration...	...if the major cutoff for PM10 is....	...Then the EPA prohibitory rule and general permit guideline for throughput, in bales of cotton ginned over a cotton ginning season, is...
Cyclones on all exhaust points	100 tpy PM10	90,000 bales* (243,900 bales)
	70 tpy PM10	63,000 bales* (170,700 bales)
Screened drums or cages on battery condenser and lint cleaner, cyclones on all other exhausts	100 tpy PM10	72,000 bales** (166,600 bales)
	70 tpy PM10	50,000 bales** (116,600 bales)

* Using 0.82 lb/bale PM10 (EPA, 1996)

** Using 1.2 lb/bale PM10 (EPA, 1996)