BIO-GENERATION ™, A SOLUTION TO GIN WASTE DISPOSAL

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Abstract

Challenges abound for cotton gins in the present era, not least of which is the disposal of by-product from the ginning process. Of particular challenge is disposal of hulls, sticks, motes and leaves. Options currently available to ginners are distribution by spreading of the by-product directly in the fields, composting as a soil amendment or windrowing for further decomposition, or as a feed supplement to commercial animal operations. Direct distribution adds little nutritional value to the field; thus, it is strictly a method of disposal, adding cost to the ginning operation. Composting prior to distribution does have some agronomic value in the field. Compost from windrows as a source for the potting industry adds revenue but only as a niche market providing incremental profits to the industry. The feed stock market has been the only viable revenue source from sales of by-product of any significance, but that market is limited and in some regions, has disappeared altogether. This paper introduces an alternate solution for gins to dispose of their waste, simultaneously generating power to operate the disposal system and provide electricity and heat for further processing opportunities.

Introduction

Mechanical harvesting of seed cottons proved to be a revolutionary advancement for the cotton industry. Consequently, cotton gins were forced to change their approach to preparation of seed cotton as the mechanically harvested cottons include a contingent of foreign materials removed by the harvester in the form of hulls, sticks, stems and leaf. One imperative was addition of new equipment by the gins specifically designed to address and remove the foreign materials, or “gin waste”. Combinations of stick, leaf and hull removing machines as well as drying systems working in conjunction with cylinder cleaners successfully remove virtually all the gin waste leaving but a small contingent for lint cleaning and/or mill cleaning to address. As the gin waste is of limited value it manifests as a waste disposal management issue and cost to the gin.

Mechanically picked cottons arrive at the gin containing between 100 and 150 pounds of gin waste per bale. Stripper harvested cottons on the other hand arrive with 300 pounds (harvester with field extractor) to 700 pounds (harvester without field extractor) of gin waste per bale. In previous years when gins processed less than 20,000 bales in a season and incinerators were common, the accumulation of gin waste at the gins was managed by burning. Today in the era of high and ultra-high capacity gins processing more than 50,000 bales during a season, management of this gin by product has become a major issue and cost center for the cotton gin. Incineration is not an option as federal and state regulations no longer permit such practices. Cotton gins are forced to stock pile gin waste (Figures 1 and 2) for further processing, often involving transportation of the material via truck or trailer (Figure 3) for distribution in local fields. Composting of gin waste is a common practice for some gins provided enough space adjacent to the gin is available and the composting area is protected from runoff which may foul local waterways. Windrow composting (Figure 4) has proven successful and somewhat profitable but not on a large scale. In recent years several stockyards and feedlots secured supplies of gin waste (Figure 5) as a feed supplement thus providing a revenue source for the gin as well as dispositioning the stockpile of material. However, this revenue source has all but disappeared as stockyards and feedlots now consider cotton gin waste to be less than desirable as a supplement.

Figure 1. Cotton gin waste pile with distribution conveyor; cottonseed bunker to the left in image.

Figure 2. Cotton gin waste pile with distribution conveyor travelling about a central axis. (Lipsey Gin Tech, Inc.)

Figure 3. Typical trash house with spreader truck.

Figure 4. Gin waste compost spread in windrows for further decomposition. (www.farmcredit.com)

Figure 5. Cotton gin waste before incorporating into a ration at the feedlot.

Cotton gins on the Texas High Plains face a unique challenge managing the shear volume of gin waste generated during ginning. One such gin processes as much as 200,000 bales during one season. The cotton is stripper harvested with field extractors on-board the harvesters. The gin waste yield averages 300 pounds per bale. The total bulk yield by season's end is 60,000,000 pounds or 30,000 tons of gin waste. At an average density of 5 Lbs/ft^3 this translates to 12,000,000 cubic feet in volume. The same amount of by-product would fill an area the size of the gin five hundred feet deep. Were it not for the use of field extractors the depth would approach twelve hundred feet. A visual comparison (Figure 6) illustrates the respective volume of a typical high capacity gin building against that of the spatial equivalent for 200,000 bales worth of gin waste from picker, stripper with field extractor and stripper with no field extractor harvested cotton.

Objectives

a. To introduce an alternative to stockpiling gin waste adjacent to the gin, hauling gin waste by truck or trailer to fields for distribution or composting gin waste adjacent to the gin, thereby mitigating the cost of waste management.
b. To introduce a self-sustaining power and heat generating gasifier utilizing cotton gin waste as the feed stock for gasification thereby dispositioning the stockpile of gin waste adjacent to the gin.
c. To manufacture and market commercial gasifiers trademarked as BIO-GENERATION ™ utilizing gin waste as the feedstock under exclusive license by Texas A&M Agrilife Research.

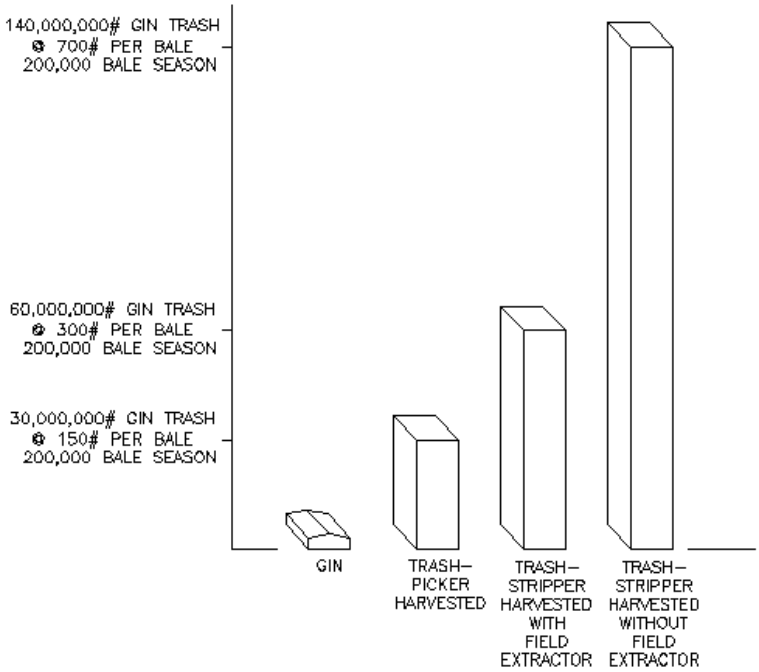

Figure 6. Relative volume of waste from 200,000 bale gin; picker, stripper with extractor and stripper without extractor.

Methods

Texas A&M University department of Biological & Agricultural Engineering (BAEN) has been working on development of gasification technology since the 1980's. Gasification is the process of converting solid biomass, or in this case gin waste, into synthesis gas (syngas) as fuel for an engine to produce electricity and heat. In addition to generating electricity and heat, gin waste as the fuel for the gasifier reaction provides a solution to the management problem of dispositioning gin waste without adding cost to the gin. Work performed by BAEN has resulted in a model utilizing gin waste as a viable raw material for the reaction. Energy required to operate the ancillary system for gasification is provided by the gasifier itself. The amount of energy used is a small percentage of the total energy developed by gasification. In the case of a 250-kw gasifier recently demonstrated at Texas A&M, 20 kw was required to operate the blower, infeed conveyor, rotary airlock and balance of ancillary components; less than 10%.

The amount of gin waste necessary to sustain a 250-kw gasifier is 1000 pounds per hour (455 kg/hour), nowhere near enough to satisfy the disposal needs of a 200,000 bale per year cotton gin producing 30 times that amount of waste. Operating 20 hours per day the 250-kw system would take 3000 days to completely dispose of 30,000 tons of gin waste. In fact, a gasification system consuming 30,000 pounds of feed stock per hour would be needed to compliment the high capacity gin in this example.

The electricity produced by the 250-kw gasifier is ample enough to supply power to a small operation, such as a gin office or work shop. The 200,000 bales per year gin would require 7 mega-watts of gasification capacity to provide power enough to operate the gin plant, or twenty-eight (28) 250-kw gasifiers. Twenty-eight gasifiers may be impractical. More than likely, seven (7) 1 mega-watt gasifiers, three (3) 2.5 mega-watt gasifiers, or some combination of both would fit the requirement. At 4 pounds of gin waste per kilo-watt (1000# gin waste /250-kw = 4# gin waste /kw), a 7 mega-watt gasification system's feedstock requirement is 28,000 pounds of gin waste per hour, well within the 30,000 pounds of gin waste produced by the gin and fittingly suited to disposition the volume of gin waste otherwise stockpiled and disposed of at substantial cost to the gin.

Summary

The Texas A&M 250 kw gasifier is a mobile unit to be located at an operating gin in Texas for field trial. One focus of the field trial is disposal of gin waste while generating power to operate the gasifier and provide electricity and heat for further processing opportunities such as a gin office, work shop or other gin support operations. The purpose of this paper is to represent the gasifier as one method to disposition stockpiles of gin waste consequential to the ginning process in such a way as to mitigate cost of waste management. Further discussion related to the science of gasification is beyond the scope of this paper.

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