Current Status

When congress passed the clean air act in 1990, it specified that refiners must use an oxygenate in reformulated gasoline (RFG) to help reduce the nation's pollution. The requirement did not specify which oxygenate was to be used. The choice by the refiners was MTBE, a refinery by product, to blend in at the refinery. However, in recent years, MTBE has been found to pose a cancer threat and has been discontinued in most states. Instead of MTBE, the predominate oxygenate used has been fuel grade ethanol.

In June of 2005, the president signed the energy policy act of 2005. This was a monumental document of legislation for America's renewable fuels industry. To achieve the agreement a compromise was made between the refiners and renewable fuels producers that the EPA would waive the 2% requirement for reformulated gasoline. This means refiners are no longer required to use any oxygenate if they can continue to meet the clean air standards. The elimination of oxygenate was effective May 5, 2006.

While this may sound like oxygenates are a thing of the past, it could not be further from the truth. The Bill H.R. 3081 dated June 28, 2005 was passed to amend the Clean Air Act to increase the production and use of renewable fuels in the United States. The bill calls for specific volumes of renewable fuel in each year 2006 through 2012 and reviewable each year within the time frame. The following table illustrates:

Calendar Year	Volume in Billions of Gallons
2006	4.0
2007	4.7
2008	5.4
2009	6.1
2010	6.8
2011	7.4
2012	8.0

Any blending components derived from renewable fuel, except that only the renewable portion of any such blending component shall be considered part of the applicable volume under the renewable fuel program. The blend equivalency is 1 gallon of ethanol or B100 shall be considered as 2.5 gallons of renewable fuel.

Ethanol and biodiesel were two key renewable fuels listed. Not only has the United States enforced renewable fuels but it has become a global issue and several countries have already passed legislation to affect their air quality standards. The historical growth of ethanol and B100 is illustrated in *Figures – 1 Ethanol Growth World Market, 2 – Biodiesel Growth World Market,* and *3 – Biofuels Facts*. The production of ethanol and B100 is illustrated in *Figures 4 – Ethanol Production Process – Dry Mill* and *5 – Biodiesel Production Process - B100 Process*.

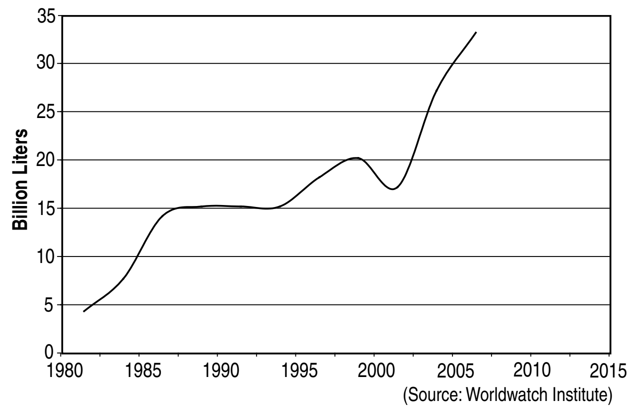


Figure 1 – Ethanol Growth World Market

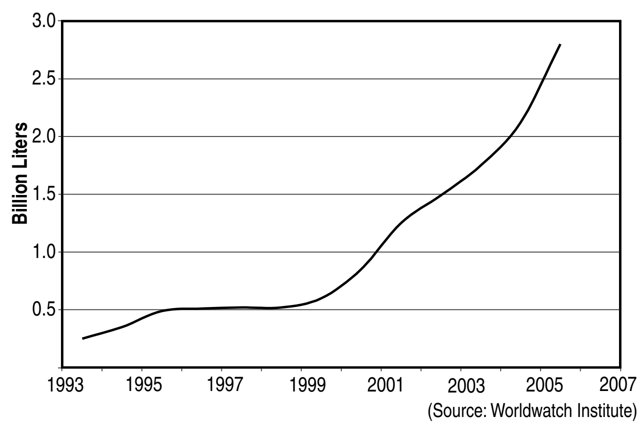


Figure 2 – Biodiesel Growth World Market

BioFuels Facts

Ethanol Production (billions of liters)		B100 Production	
Brazil	15.2	USA	0.3 (53 plants)
USA	14.9 (81 plants)	World	1.8
World	32.5		

Figure 3 – Biofuels Facts

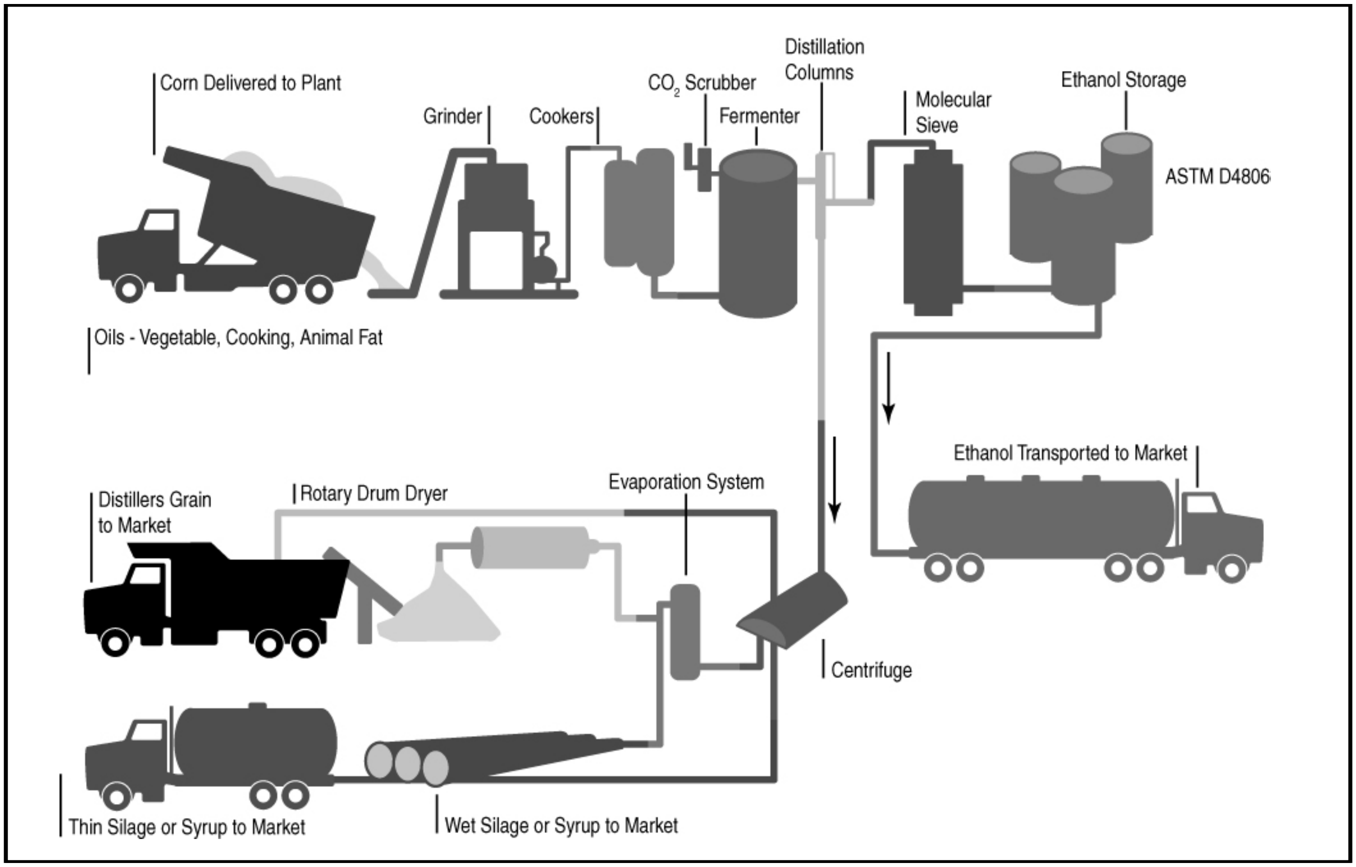


Figure 4 – Ethanol Production Process – Dry Mill

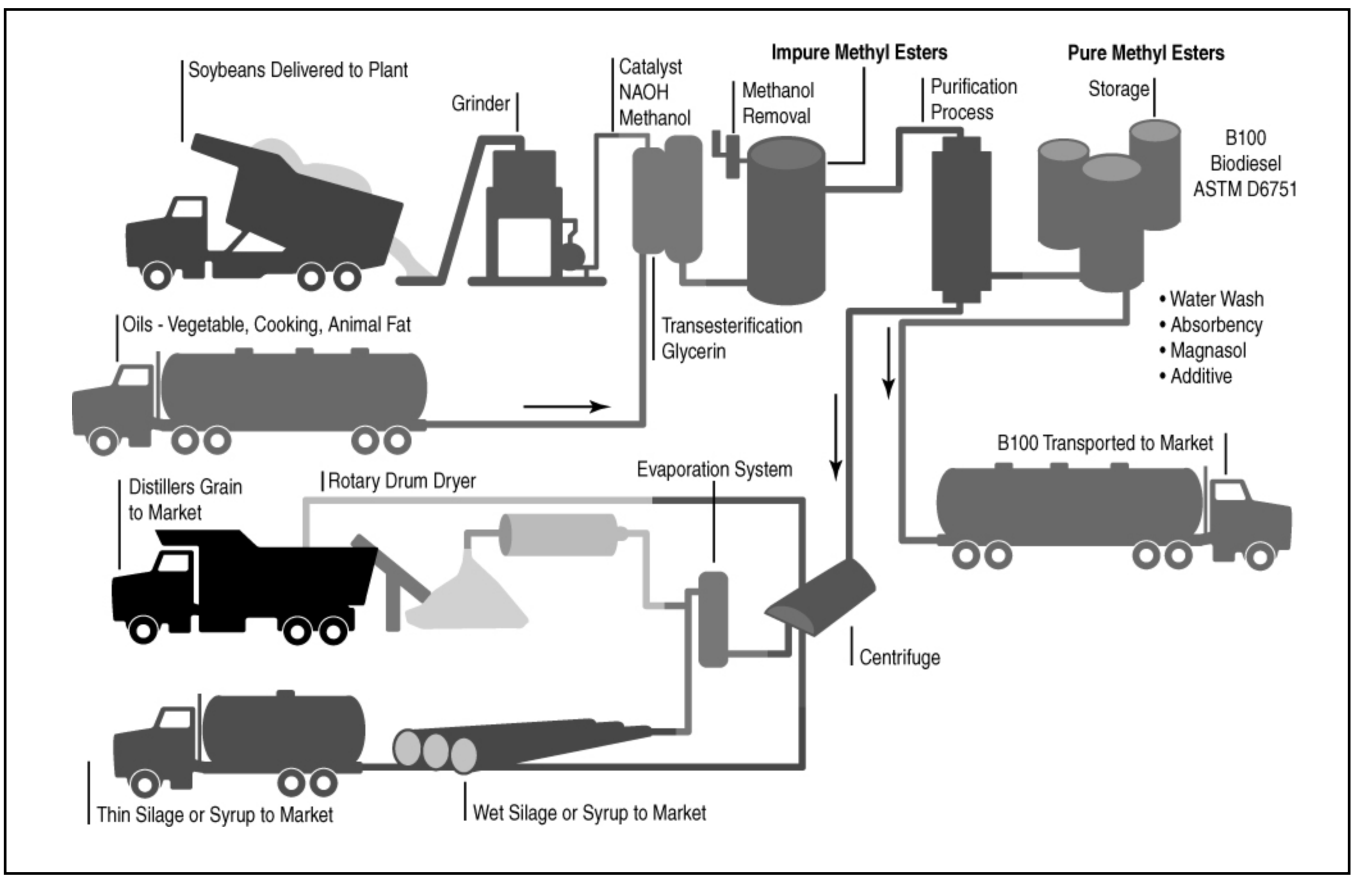


Figure 5 – Biodiesel Production Process – B100 Process

The Products

Ethanol

Fuel Grade (Denatured) Ethanol is manufactured to Standard ASTM D 4806-4a.

Performance Requirements –
(When blended with gasoline)

Ethanol, volume %, min.	92.1
Methanol, volume %, max.	0.50
Solvent-washed gum, mg/100ml, max.	5.00
Water content, volume % max.	(agreed between buyer and seller)
Denaturant content, volume % min.	1.96
Denaturant content, volume % max.	4.76
Inorganic chloride content, mass ppm (mg/L), max	40 (32)
Copper content, mg/kg, max.	0.10
Acidity (as Acetic acid)	0.007 (56)
Mass % (mg/L), max. pHe	6.5 to 9.0
Sulfur, mass ppm, max.	30
Appearance	Clear and bright free of suspended particulate

See *Figure 4 – Ethanol Production Process*

Ethanol has some unique issues with regards to handling and blending.

Ethanol is basically a solvent and will clean tank wall and pipe surfaces. This could create problems with equipment downstream of the process. Caution should be taken to flush all lines through a line strainer to be sure any residue has been collected before installing metering equipment.

Ethanol also has an affinity for water and care must be taken to avoid phase separation of gasoline-ethanol blends, especially at low temperatures. This creates issues later in combustion engines.

Contrary to some arguments, gum content is not of particular concern in a closed pipe system. Reports refer to issues with engines parts when fuel-insoluble gum can be deposited on surfaces when the fuels evaporate. Care in maintenance should be noted when reinstalling metering equipment.

There is still the outstanding question with regards to a volumetric growth when blending ethanol with gasoline. When ethanol and gasoline are blended there is a chemical reaction that is endothermic. Ethanol is a bi-polar solvent. Hydrogen bonds are normally present in gasoline and the molecules are pulled closer together. When the ethanol is mixed with the gasoline these hydrogen bonds are broken. This chemical reaction causes the mixture to change volume. Also, because the reaction is endothermic there is a temperature drop that occurs at the same time. This endothermic change also differs in magnitude with different recipe percentages of each component.

This change raises several questions: How is the temperature drop handled?, How is the volume change handled?, How are the individual inventories reconciled with delivered transactions?, How does weights and measures handle the issue? And finally what is the proper method for blending to ensure that neither the seller nor buyer assumes a loss?

With temperature and mixing at the top of the list of concerns it is necessary again to review the various types of blending.

Case 1

Splash blending – loading the individual products into the truck through dedicated product meters one after the other. The endothermic reaction occurs in the truck.

Case 2

Sequential blending – loading the individual products through the same meter sequentially. The endothermic reaction occurs in the truck.

Case 3

Ratio blending – loading the individual products through dedicated product meters simultaneously and blending in a downstream connection. The endothermic reaction occurs in the downstream pipe or essentially in the truck.

Case 4

Wild stream or side stream – metering the ethanol product into the main gasoline line where the blending occurs directly upstream of the larger delivery meter. The endothermic reaction occurs prior to the delivery meter.

To answer the general questions stated above regarding growth, *Figure 6* will be the reference. This data basically says that when blending a 90/10 Gasoline Ethanol mixture there is definitely an Endothermic Reaction that causes the temperature to drop instantly on the average of 4.6° degrees F. From the table it also indicates there that at the point of mixture there is molecular change that increases the volume about 0.04%.

Sample No.	et-OH Vol.	Gas Vol.	et-OH Temp.	Gas Temp.	Mix Temp.	Final Temp.	Mix Vol.	Final Vol.
1	100.00 ml	900.00 ml	64.5° F	64.5° F	60.0° F	64.5° F	1000.3 ml	1000.5 ml
2	100.00 ml	900.00 ml	64.5° F	64.5° F	59.9° F	64.5° F	1000.5 ml	1000.7 ml
3	100.00 ml	900.00 ml	62.2° F	62.2° F	57.4° F	62.2° F	1000.4 ml	1000.6 ml
4	100.00 ml	900.00 ml	62.2° F	62.1° F	57.4° F	62.2° F	1000.5 ml	1000.6 ml

Figure 6 – 90/10 Ethanol/Gasoline Blend Endothermic Reaction Lab Test Results

Ratio Blending											
Gasoline			Ethanol			Prover or Truck Instantaneous Affect			Prover or Truck Recovered Temp.		
Temp.	Gv	Nv	Temp.	Gv	Nv	Temp.	Gv	Nv	Temp.	Gv	Nv
64.5	900	897.2	64.5	100	99.72	60	1000.3	1000.3	64.4	1000.5	997.37

SideStream Blending									
1,000 Gallon Batch Gross Volume Preset; 90% Gasoline, 10% Ethanol	Delivery Meter Blended Volume			Prover or Truck Instantaneous Affect			Prover or Truck Recovered Temp./Volume		
	Temp.	Gv	Nv	Temp.	Gv	Nv	Temp.	Gv	Nv
	60	1000.3	1000.3	60	1000.3	1000.3	64.4	1000.5	997.37

Comparison of Two Methods
Ratio Blending = Nv Gasoline + Nv Ethanol = 897.2 + 99.72 = 996.92 Gallons
SideStream = Blended Volume @ 60°F or = 1000.3 Gallons
Difference = 1000.3 -996.92 = 3.38 Gallons or + 0.34%
Customer receives the recovered volume of 1000.5 gallons @ 64.4°F
Customer is billed 1000.3 Gallons @ 60°F

Coefficient of Thermal Expansion
Gasoline = 0.00069/degrees F
Ethanol = 0.00063/degrees F
90/10 = 0.00071/degrees F

Figure 7 – Example of 90/10 Ethanol/Gasoline Blend Corrections

A simple lab test was devised to measure the instantaneous and final growth of the blended 90/10 ethanol and at the same time record temperatures. *Figure 6* shows the results of the lab test.

Figure 7 is a simulated example of what a 1000 gallon proving run or transaction might show when using the data from *Figure 6*. This example shows the net result using two different methods of blending. Splash Blending, Sequential Blending and Ratio Blending will all give similar results as the mixing occurs after the metering. The two methods for the example are; Ratio and SideStream. The example assumes 60 API gasoline with a C of E of 0.00069, denatured ethanol in accordance with the ASTM standard with a C of E of 0.00063, and of C of E for blended product of 0.00071.

It should be noted that these tests were conducted at near 60° degrees F. In other tests performed the molecular change showed a much lower molecular volume increase when the product temperatures were near 30° degrees F. Other affects such as pressure, different percentages of each product, and ambient affects may have an impact on the amount of growth.

For the purpose of these tests and in order to determine the real growth, the blended product was allowed to recover to its original temperature. This took place in less than 12 minutes. This brought out a primary concern and that being that as soon as the product was mixed and delivered to a vessel it began a recovery in temperature. This means the net volume transferred is "unstable" for some period of time. This can have serious affects on meter factor calculations and actual consumer deliverable volumes, both of which could be issues with the Departments Weights and Measures.

The conclusion is one that the user must decide what is the best method to use for custody transfer in the spirit of Fair Trade and accurate inventory reconciliation of inventories.

Biodiesel Fuel Blend Stock (B100)

ASTM D 6751 – 06

Performance requirements –
(When blended with middle distillates)

Grade S15 and S500 limits

Flash Point, degrees C, min.	130.0
Water & Sediment, volume %, max.	0.050
Kinematic Viscosity, at 40° degrees C, mm2/s	1.9-6.0
Sulfated ash, mass %, max.	0.020
Sulfur, mass %, ppm, max.	0.0015 (15) Grade S15 0.050 (500) Grade S500
Copper strip corrosion, max.	No. 3
Cetane no., min.	47
Cloud point	See report
Carbon residue, mass %, max.	0.050
Acid No., mg. KOH/g, max.	0.500
Free Glycerin, mass %	0.020
Total Glycerin, mass%	0.240
Phosphorus content, mass %, max.	.0010
Distillation Temperature, degrees C, max.	360
Atmospheric Equivelent Temperature 90% recovered Sodium and Potassium combined	5 ppm (ug/g), max.

See Figure 5 – Biodiesel Production Process-B100 Process.

Not unlike ethanol, B100 has some unique issues as well.

Viscosity can be an important factor. The upper limit for the viscosity of B100 is 6.0 cst. At 104° degrees F it is greater than the maximum allowable viscosity of low sulfur diesel which is 4.1 cst. At 104° degrees F. blending B100 with diesel fuel close to its upper limits could result in off spec final product.

The cloud point is of great importance in that it defines the temperature at which a cloud or haze of crystals appears in the fuel under prescribed test conditions which generally relates to the temperature at which crystals begin to precipitate from the fuel. B100 generally has a higher cloud point than diesel fuel. The cloud point of B100 and its impact on the cold flow properties of the resulting blend should be monitored in cold climates. Generally speaking it is best to keep B100 at least 10° degrees F. above its cloud point when blending diesel fuel in cold climates. Most companies will heat trace and insulate all components of the B100 piping system including the tank, piping to the rack, metering equipment up to the loading arm and maintain the B100 at around 70° degrees F in cold climates.

Ash forming materials may be present in B100 in 3 forms: (1) abrasive solids, (2) soluble metallic soaps and (3) unremoved catalysts. For these reasons it may be necessary to use filtering prior to pumping product to the rack.

Because B100 is organic, fungi and bacteria can form at any fuel-water interface and give high particulate concentrations in the fuel. In storage the use of biocides or biostats destroy or inhibit the growth of fungi and bacteria. These reagents are soluble in either the fuel or water phase.

With temperature and mixing at top of the list of concerns it is necessary again to review the various types of blending

Case 1

Splash blending – loading the individual products into the truck through dedicated product meters one after the other. Products will not mix well in the truck and stratification will occur causing poor fuel quality.

Case 2

Sequential blending – loading the individual products through the same meter sequentially. In a study, qualitative visual observations of sequential blending B100 with diesel showed clouding and possible crystallization of the fuel due to inadequate mixing.

Case 3

Ratio blending – loading the individual products through dedicated product meters simultaneously and blending in a downstream connection. This scenario works well for general blending but may require additional mixing prior to loading the truck such as an in-line mixer.

Case 4

Wild stream or side stream – metering the B100 into the main diesel line where the blending occurs directly upstream of the larger delivery meter. This scenario works well and will also aid in mixing as the blend passes through a meter that mechanically mixes or integrates the fuel.

Blending System Configurations and Equipment

FMC Technologies is the leading supplier of Smith Meter® products for tank truck loading measurement and control equipment with:

- Experience - Over 70 years of experience in terminal applications worldwide – more than any other supplier.
- Worldwide sales and service - Local support before and after the sale.
- All current technologies with PD (Positive Displacement), Turbine, and Coriolis meters.
- The broadest offerings of blending configurations including sequential, ratio, side-stream, and a brand new version of a combination of sequential with ratio (hybrid).
- Accessory equipment with transmitters, strainers, air eliminators, self contained and externally powered flow control valves.
- Communications interface with most current terminal automation suppliers.
- Worldwide approvals for equipment that meets or exceeds most Weights and Measures and electrical requirements.
- Complete prepackaged truck loading and unloading skids.

Powerful Solutions

The Smith Meter® AccuLoad® III can be configured to fit the application. It can be set up as a single arm device or up to a six arm device in one Class I, Division I housing or using the Split Architecture platform, can accommodate up to eighteen loading arms.

Any of the AccuLoad III controller configurations can be set up as a unique blender. In any AccuLoad III, the arms can be configured as sequential, ratio, sidestream or hybrid. The AccuLoad III can use any combination of these types of blenders with a specific type assigned to a given arm.

For example, a ratio blended gasoline arm, a sequential blended distillate arm, a 'hybrid' arm for ratio blending of bio-mass into sequential blended diesels (illustrated in the diagrams on page 8).

Blending Considerations

Recipes

Blending of two or more products by any method requires a recipe. A recipe is derived from the components of the blend and the percentages of each component. When sizing equipment, it is necessary to calculate the flow range of each component using the component percentage(s) and the loading arm flow range (minimum to maximum). These calculations will determine meter and valve sizes and indicate any problematic flow control issues.

Product Measurement Profiles

Each product has its own unique set of characteristics that affect measurement. Parameters such as meter factors, API tables, density, etc., will need to be considered for the individual components in the recipe in order to deliver an accurate blend and maintain component inventories.

Product Flow Profiles

Any product delivery, including straight product loading, and any type of blending requires that each component be capable of accurately flowing in a controlled mode throughout the delivery batch. This flow profile is most critical for ratio or hybrid blenders. If pumps and flow control valves are not sized properly, the results will be erratic operation and off-spec blends. Complete pressure profile analysis should be done for all operating conditions to ensure accurate blending.

Product Mixing

Products with similar characteristics, such as density and viscosity, will generally blend well. Products with different characteristics or those that when blended simply do not mix or stay mixed may dictate the method of blending or some other special consideration. Ethanol, for example, may have a tendency to stratify in gasoline. Other Bio-Mass may not mix well with distillates.

Types of Blending

Sequential

Sequential blending is defined as loading multiple products one at a time through one meter and control valve. This method is most common for products that mix well. The recipe contains the percentage of each component. When a recipe is selected, the AccuLoad will calculate the exact amount of each component. Each component is then delivered as a type of "mini batch", complete with the specific product measurement and product flow profiles. Products are delivered in the order programmed by the user. The "mini batches" and product sequence are converted by the AccuLoad opening and closing the appropriate product block valve. The product block valve should be motor operated and fast operating to minimize sequence loading time. Check valves should be installed in each product line and should be as close to the blend connection as possible to prevent backflow and contamination.

Ratio Blending

Ratio blending is defined as loading multiple products into a truck at the same time. Unlike sequential blending, ratio blending has a meter and control valve for each product. Because the products are blended at the same time they will have a tendency to mix better than with sequential blending. Also, because all products are running during the entire batch, the blend should be on spec at any time during the batch; therefore, if a batch is aborted, the product loaded should be a deliverable product. For a sequential blend to be on spec, the entire batch must be completed.

The AccuLoad can accommodate typical ratio blending where all products are mixed in the piping downstream of the individual product control valves. It can also handle side stream blending where the smaller of the components is plumbed in upstream of the main product delivery meter.

Hybrid Blending

Hybrid blending is a combination of sequential and ratio that is primarily designed for ratio blending soybean oil into existing No. 1 and No. 2 diesel oil sequential blenders. In any ratio or hybrid blender, meter and flow control valve sizing are critical. The system hydraulics in ratio blending must be carefully designed to ensure accurate blending. Once again, check valves need to be installed to prevent backflow and contamination.

Critical Issues for Different Blending Configurations

The objective in biofuels blending is to deliver an accurate quality blend. The seller has requirements as does the buyer. The seller, for example is concerned about the exact volumes delivered in the blend recipe for billing purposes, inventory reconciliation, blend quality, regulatory requirements, safety and loading time. The buyer is most interested in exact volumes delivered in the blend recipe and quality of the blend. Each one of these issues whether for the seller or the buyer represents a unique issue for each type of blending.

The following are some of the typical concerns:

One common issue for all types of blending is what is known as "Clean Line Flush". This is the last product delivered to lay down the line with a product that will not downgrade or contaminate the next load. The "Clean Line Flush" should be minimized by design. In other words the length line from the last control valve or check valve to the loading arm should be as short as possible to minimize octane give-away with a Premium Line Flush, or to minimize contamination if using a sub-octane Line Flush.

Sequential Blending

Exact Volumes and Inventory Reconciliation

In sequential blending the AccuLoad calculates the exact volumes to be delivered based on the recipe percentages and delivers them within the accuracy of the meter. The control valve must also have a repeatable zero shut-off to prevent under-delivery or over- delivery of the final product in the recipe. The Block Valves, that sequence the products must be opened one at a time and monitored for positive shut-off. Likewise check valves should used in each product line to prevent contamination or even back flow. Also, the Clean Line Flush Volume is subtracted from any available product at that arm. The Line Flush Volume does not have to be one of the products in the current delivery recipe. However, the Clean Line Flush Volume is recorded and added into the correct product totals in the AccuLoad so that inventories are correct.

Blend Quality

In sequential blending the entire preset must be delivered to ensure that the proper amounts were delivered for each component of the recipe. If the preset is aborted for any reason, the product delivered is off-spec. Typically presets will have the facility to allow the blend to be corrected, either by a simple restart to finish, or the preset should determine how much of each product is needed to finish a quality blend.

Regulatory Requirements

As long as the Blend Quality is maintained, any regulatory requirements should be met. Additives may present another issue. AccuLoad has many configurable methods for additive control, regulation and reporting.

Safety

The control valve must be a fast, shock-free type valve that is capable of accurate and repeatable zero balance shut-off. The AccuLoad has many control valve configurable parameters that permit individual set up for each valve depending on the operating conditions of that product. The AccuLoad also has many safety parameters that monitor control and shut-off to alert the possibility of a spill or accident.

Loading Time

This is one of the disadvantages for sequential blending. The time it takes to check the position of and cycle the appropriate product valves adds to the delivery time of the entire transaction.

Ratio Blending

Exact Volumes and Inventory Reconciliation

In Ratio Blending the AccuLoad calculates the exact volumes to be delivered based on the recipe percentages and delivers them within the accuracy of each of the product meters at that particular loading arm. While delivering the exact volumes of each product in the recipe the control valves for each product in the recipe are controlling the flow rates that correspond to their respective percentages of the recipe. This way the blend ratio is kept on-spec as close as possible throughout the entire preset. At the end of the preset the blend will be accurate and on spec. The control valves must also have a repeatable zero shut-off to prevent under-delivery or over-delivery of the final product in the recipe. Check valves should be used in each product line to prevent contamination or even back flow. Also, the line flush volume is subtracted from any available product at that arm. The line flush volume does not have to be one of the products in the current delivery recipe. However, the Clean Line Flush Volume is recorded and added into the correct product totals in the AccuLoad so that inventories are correct. Because the AccuLoad must control flow rate at each product's blend percentage over the entire delivery including low-flow start, as well as high-flow and low-flow shut down, it is critical to have well designed hydraulic operating conditions for each product allowing the valves to operate properly, accurately and safe. Loading arm pressure and flow profiles must be considered before designing a Ratio Blending System.

Blend Quality

In Ratio Blending the blend quality is dependent most typically on system operating conditions and selecting and sizing the meters and valves according to the system operating conditions. Typically, if all is designed properly, the Ratio Blender will be on spec at all times.

Regulatory Requirements

As long as the Blend Quality is maintained, any requirements should be met. Additives may present another issue. AccuLoad has many configurable methods for additive control, regulation and reporting.

Safety

The control valves must be fast, shock free type valves that are capable of accurate and repeatable zero balance shut-off. The AccuLoad has many control valve configurable parameters that permit individual set up for each valve depending on the operating conditions of that product. The AccuLoad also has many safety parameters that monitor control and shut-off to alert the possibility of a spill or accident.

Loading Time

Loading time is not an issue as compared to Sequential Blending since all products run at the same time.

Side Stream Blending

Exact Volumes and Inventory Reconciliation

In Side Stream Blending the delivery meter total is the delivered blend. The exact volumes of each product are derived by subtracting the secondary component total from the delivery total. Their individual accuracy is still dependent on the accuracy of the product meters at that particular loading arm. This is also the means by which inventories are established. In Side Stream Blending, the secondary component is metered into the main delivery line by rate and volume against the main line delivery meter and its control valve. The secondary product must be pumped into the main product line at a higher pressure in order to get the product into the main line. This can create some issues for the secondary product control valve especially if the valve is required to operate at low flows and/or over a wide flow range. If the secondary valve is too cyclic and has erratic operation because of system hydraulics, the delivery meter and control valve respond in like fashion resulting in poor delivery and possibly off spec blends. The control valves must also have a repeatable zero shut-off to prevent under-delivery or over-delivery of the final product in the recipe. Check valves should used in each product line to prevent contamination or even back flow. Also, the Line Flush volume is subtracted from any available product at that arm. The Line flush volume does not have to be one of the products in the current delivery recipe. However, the Line Flush volume is recorded and added into the correct product totals in the AccuLoad so that inventories are correct.

Because the AccuLoad must control flow rate for the main and secondary products for the blend percentages over the entire delivery including low flow start, high flow and low flow shut down, it is critical to have well designed hydraulic operating conditions for each product allowing the valves to operate properly, accurately and safely. Loading arm pressure and flow profiles must be considered before designing a Ratio Blending System.

Blend Quality

In Side Stream Blending this is dependent most typically on system operating conditions and selecting and sizing the meters and valves according to the system operating conditions. This is extremely critical for real low flows such as Biodiesel Blending for B2 and B5 recipes.

Safety

The control valves must be fast, shock-free type valves that are capable of accurate and repeatable zero balance shut-off. The AccuLoad has many control valve configurable parameters that permit individual set up for each valve depending on the operating conditions of that product. The AccuLoad also has many safety parameters that monitor control and shut-off to alert the possibility of a spill or accident.

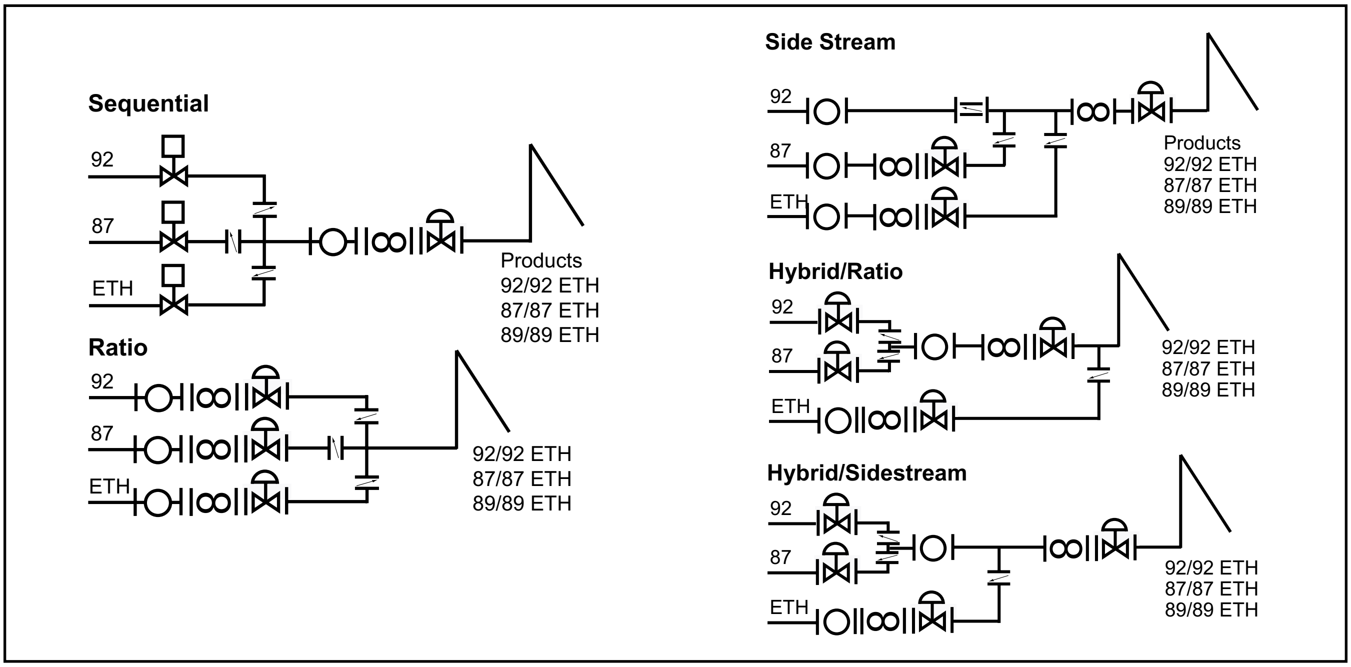
Loading Time

Loading time is not an issue as compared to Sequential Blending since all products run at the same time.

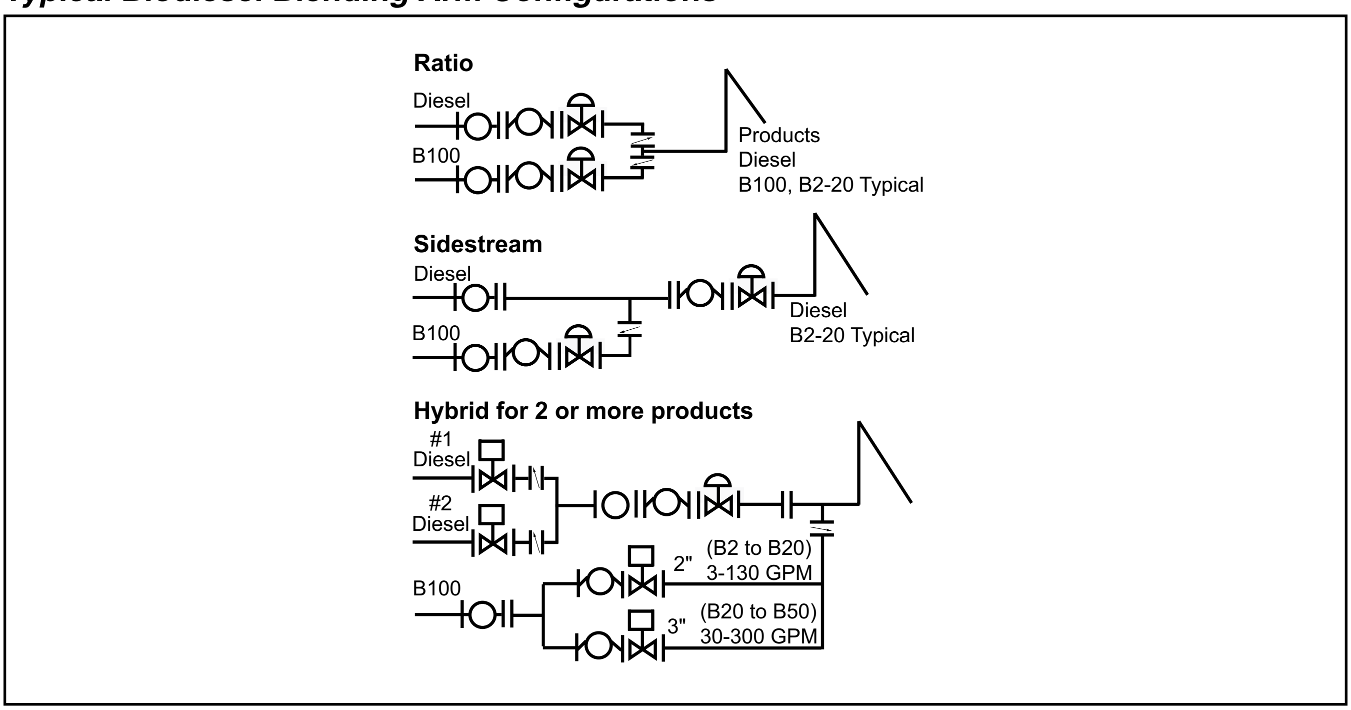
Hybrid Blender

This combination of both Sequential and Ratio Blending carries the same issues as the individual methods and therefore all considerations must be addressed.

Typical Ethanol Blending Arm Configurations



Typical Biodiesel Blending Arm Configurations



Ethanol or B100 Unloading *(See to Figure 8)*

Delivery of Ethanol and B100 to the terminal should be metered. The process should be accurate, safe and fast. In order to accomplish this there are a number of issues to consider.

The AccuLoad has all the necessary controls to perform a successful unloading. This mode of delivery allows for unloading the truck without setting a preset volume. Controlled delivery is accomplished by the use of three digital inputs, configured as; stop, low and high flow switches. These switches are located on a float installed in an air elimination tank upstream of the meter. The inputs define when to open the control valve, when to advance from low flow to high flow and when to close the valve. The switches are set based on the product/air interface in the air eliminator tank.

Referring to *Figure 8*, other than the meter and control valve the most critical item is the unloading pump. With the objective of unloading the truck completely and quickly, it is necessary to have a pump that accomplishes just that. Centrifugal pumps can be problematic in completely unloading the truck once air has entered the pump casing. It is recommended to use a positive displacement pump or a self-priming centrifugal pump in order to completely off load the truck. The AccuLoad, control valve and air elimination system is design to handle the operating conditions when air is encountered at the end of the load. It is critical to make certain the proper pump has been chosen for the installation and unloading conditions.

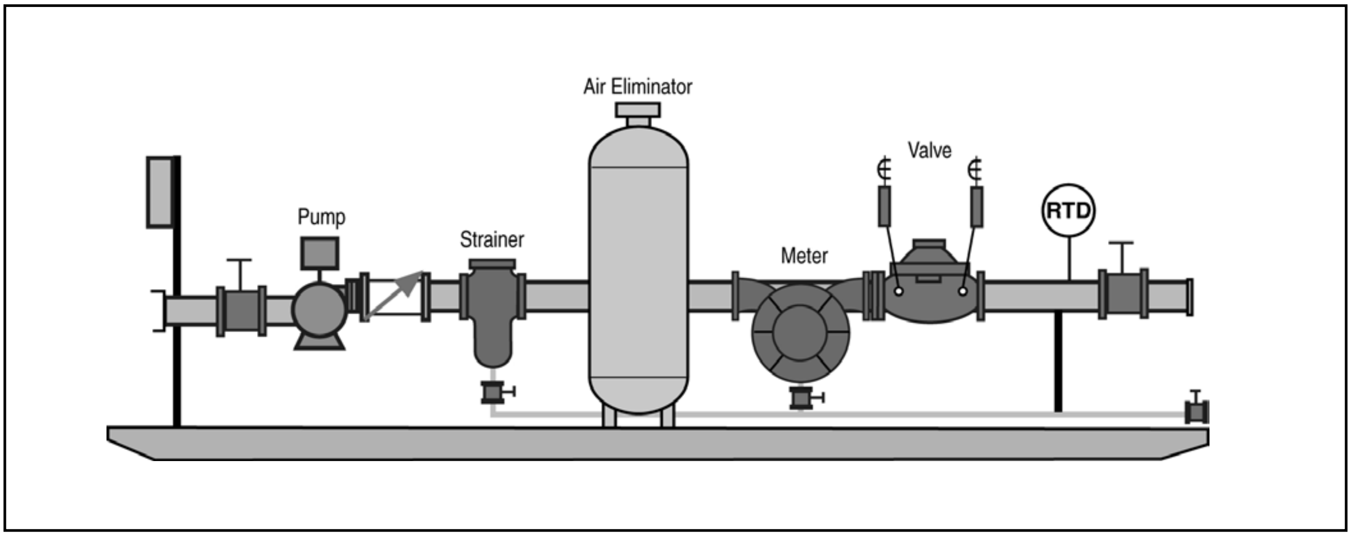


Figure 8 – Ethanol or B100 Unloading

Revisions included in TP0A015 Issue/Rev. 0.1 (12/07):

Page 1: Corrected Figures 1 and 2.

Page 8: Editorial Change - Typical Ethanol Blending Arm Configuration - picture on right has been switched with Typical Biodiesel Blending Arm Configuration picture.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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