AIR EMISSION REQUIREMENTS - PAST, PRESENT AND FUTURE

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ABSTRACT
Historically, the glass industry has been faced with gradually more stringent air emission control regulations. This paper will provide an overview covering the evolution of regulations for glass furnaces, key issues associated with controlling the current criteria pollutants, and an understanding of near future control requirements.

INTRODUCTION
The process of converting industrial minerals to molten glass in high temperature furnaces has certain inherent gaseous and solid particulate emissions into the earth atmosphere. The growing awareness of concerns with air emissions resulting in health concerns has led to an ongoing evolution of more stringent regulations to limit emissions from most industrial processes, including glass melting. From a regulatory perspective, most legally imposed regulations have significantly impacted the glass industry over the past five decades.

The "Pollution Prevention and Abatement Handbook" defines Air Pollutants as: "Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or in combinations of these forms. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photo-activation. Exclusive of pollen, fog and dust, which are of natural origin, about 100 contaminants have been identified and fall into the following categories: solids, sulfur compounds, volatile organic chemicals, nitrogen compounds, oxygen compounds, halogen compounds, radioactive compounds, and odors."

To varying degrees, the following categories of air pollutants are potentially emitted from a high temperature glass melting process and may exist in the "stack" exhaust gases.

Products of Combustion Gases

NO_X - An inherent by product where Nitrogen is present within the combustion process
CO - A remnant of incomplete combustion of a carbon containing fuel
SO_X - An oxidized gas by product of Sulfur in the fuel

Batch Raw Material Ingredient Evolution

SO_X - The evolution product of sulfur containing raw materials, typically from the refining process
Condensable Particulate - Compounds created within the cooling exhaust proeess of gases evolved from the melt (including Alkali, Borates, Sulfates, and Carbonates)
Heavy Metals - Compounds of low vapor pressure metals (such as Arsenic, Lead, Selenium, etc.)

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Solid Dust - Very fine particles of raw materials entrained on the exhaust gases

Refractory Sourced Emissions

Chrome Compounds - Chromic Oxide refractories having reacted with glass making raw materials

The methods actually employed for reaching compliance with environmental regulations will depend upon many factors - including specific furnace design, site constraints, relative capital investment vs. operating costs, risks relating to labor and maintenance requirements, and the potential impact upon glass quality or production efficiencies. Some of the control technologies being employed on glass furnaces include -

NO_X - Process Modifications, Oxy Fuel, Ammonia Injection , Air Staging, Gas Reburn
SO_X - Avoid Sulfur containing Fuels, Batch Sulfate alternatives , Add-on Scrubbers / Reactors
Particulate - Add-ons (Bag Houses, Electrostatic Precipitators, Scrubbers)

PARTICULATE ISSUES

Historically, glass furnaces were first regulated for particulate. Visual emissions by stack opacity were typically restricted to less than 20 % ("#1 Ringlemann" equivalent). For Soda-Lime glasses, the predominant particulate chemistry is sodium sulfate, while alkali borate particulate occurs from Fiber Glass and other Borosilicate glasses. Common process modifications and best practices, adopted by furnace operators to minimize condensable particulate emissions, have historically included:

- Reductions in Batch Sulfate levels and optimization of the refining process
- Reformulating of Borosilicate glasses to reduce or eliminate B_2O_3
- Effective Batch Wetting and raw material particle size optimization in the batch charge
- Higher Cullet content, resulting in less Sulfate per ton of glass melted
- Electric Boosting to limit melt surface temperatures and sustain required pull rates
- Furnace Design configurations to avoid aeration of batch particles, promote glazing of the initial batch charge surface, and to reduce gaseous velocities over the melt surface
- Conversion from Fossil Fuel Oil combustion to no ash, low sulfur fuels (natural gas)
- All- Electric Melting

Most operating permits incorporated maximum pull rates, maximum firing rates, maximum temperatures and other quantified limits based upon the above mentioned process variables; and often limited to values occurring during compliance demonstration testing. State and regional authorities (New Jersey and California) began setting mass emission limits for particulate in the early 1970's.

Any facility that commences *construction or modification* after June 15, 1979, is subject to the requirements of the Federal New Source Performance Standards. - *40 CFR 60.292 Standards for Particulate Matter.* Limits are expressed in grams of particulate per kilogram of glass melted, and vary for "New" vs. "Modified" furnaces, as well as the type of fuel. Most furnaces also have visual opacity limits significantly below 20 %, with a limit often based upon actual measurements taken during compliance demonstration test periods.

The requirement of compliance with the Federal NSPS and appropriate permitting for a furnace is typically triggered by one of the following conditions.

- Construction of a new facility after 6/15/79
- Any physical or operational change to an existing facility resulting in an increase in emission rate
- A designated unit considered a "replacement" for an existing unit
- A "reconstructed" facility costing > 50 % of the "fixed capital cost" of a comparable new facility

"New Source" standards are more restrictive than those for a "Modified Source". Existing sources converted to Oxy-Fuel have been considered by some agencies as a "process modification", if their is no increase in Particulate emissions.

Specific definitions are used to apply the rule's requirements, including:

> *"Glass melting furnace"* means a unit comprising a refractory vessel including foundations, superstructure and retaining walls, raw material charger systems, heat exhaust, melter cooling system, exhaust system, refractory brick work, fuel supply and electrical boosting equipment, integral control systems and instrumentation, and appendages for conditioning and distributing molten glass to forming apparatuses.
>
> *"Rebricking"* means cold replacement of damaged or worn refractory parts of the glass melting furnace. Rebricking includes replacement of the refractories comprising the bottom, sidewalls, or roof of the melting vessel; replacement of refractory work in heat exchanger; replacement of refractory portion of the glass conditioning and distribution system.

SO_X ISSUES

Other than Los Angeles, there are no SO_X emission limits stringent enough to impact natural gas fired glass furnaces in the U.S. The primary source of SO_X emissions come from Sulfates in the batch, which are the major contributor of Particulate in Soda-Lime glasses. Present practice for Soda-Lime is to use low sulfate batches, and consequently SO_X emissions are less than 1.0 gm / kg. (2 lbs. per ton of glass melted).

NO_X ISSUES

Southern California's SCAQMD Rule 1117 set the first significant NO_X limits in the country. Prior to 1987 the container glass industry had historically uncontrolled NO_X emissions from conventional regenerative container glass melting furnaces in the range of 8-10 lbs/ton of glass pulled. Float furnaces often have NO_X emissions in excess of 20 lbs. / ton. Rule 1117 (Emissions of Oxides of Nitrogen from Glass Melting) called for significant reductions in NO_X emissions in 1987 to 5.5 lbs/ton and 4.0 lbs / ton in 1993. Other agencies have set similar limits for Container Glass. California's San Joaquin Valley's NO_X Rule 4354 now restricts Float Glass furnaces to 7.0 lb. / ton.

Process Modifications have been investigated and pursued since the California Air Resources Board (CARB) Model Rule was developed in the early 1980's. Since 1987, most of the practical options listed below were implemented by existing facilities to meet Los Angeles' original Rule # 1117.

- Excess O_2 control through Mass Flow Ratio control and continuous O_2 measuring sensors
- Higher levels of Electric Boost to lower combustion zone temperatures
- Increased Cullet additions for reduced Gas firing rates
- Sealed, Low Velocity Burner systems integrated into Port design changes for flame shaping

Each furnace and facility have unique, site specific differences. To meet compliance with specific NO_X limits regulation, the following strategies have been utilized on air fired furnaces:

- Oversized melter with heavy electric boost, high cullet and lower pull rates
- End-Port firing on Oil with added Scrubber & Bag House for SO_X and Particulate Control
- Converted Side Port to Large End Port, using Under Port Sealed Burner System
- Low Bridgewall Temperature and heavy boost
- Addition of Oxy-gas boost burners
- Furnaces using Nitrates in the batch are limited to ~ 7 lb. / ton
- Ammonia Injection
- Sorg LoNOx Furnace
- Batch / Cullet preheating to lower energy input

In the past, glass furnaces had essentially no CO limits (typical furnaces were less than 20 ppmv, unless combustion modifications were being used for NO_X control). The latest standard in California imposes a 30 ppmv limit in the San Juaquin Valley with Rule 4353.

CAAA 1990

The Federal Clean Air Act Amendment of 1990 established ambient air quality standards for Ozone. Regions not in compliance with the standard are required to regulate NO_X emitters (including glass furnaces). Areas with worse air are setting more stringent standards.

Title I addresses urban air quality problems in non-attainment areas. Three air pollution problems are covered: smog /ozone, caused by nitrogen oxides (NO_X) and volatile organic compounds (VOC's); carbon monoxide (CO); and particulate matter. Glass manufacturing is listed as a category of sources that contribute to non-attainment of the national ambient air quality standard for PM_{10} (particulate matter less than 10 microns) and $PM_{2.5}$ (less than 2.5 microns). In reality, most condensable particulate from glass furnaces is less than 2.5 microns.

The EPA has classifications for smog /ozone include *marginal, moderate, serious, severe,* and *extreme*. Depending on an area's air pollution severity, the EPA enforces regulations for specify different air pollution control limits and plant's must implement appropriate control measures.

Title III seeks to control 189 *Hazardous Air Pollutants* (HAPs, also called air toxins) that are hazardous to human health or the environment. HAPs are typically carcinogens, mutagens, and reproductive toxins.

Major sources are defined as emitting 10 tons / yr. or more of any HAP or 25 tons / yr. of any combination of HAPs. EPA indicates it may decrease the emissions level required for classification as a major source from 10 tons / yr. to tons / yr. or even 0.1 tons / yr. These will require the EPA to issue control standards, called *Maximum Achievable Control Technology* (MACT) standards, for each source category.

The standards will be based on the best demonstrated control technology or practices within a specific industry. Different standards will apply to existing and new sources. If a plant is an existing source, the MACT standard can be a control technique that is at least as stringent as the average of the cleanest 12 percent of sources in the same industry. But if it is a new source, the control technique can be no less stringent than the best-controlled existing major source.

Title V enacts a national operating permits program for any major source subject to Title I or Title III and must obtain an operating permit to ensure the plant complies with the applicable requirements. "Major Sources" requiring permits are defined as having the potential to emit 10 tons per year of a single or 25 tons of combined hazardous air pollutants. The permitting procedure better defines emission inventories to be used for setting emission caps or forced reductions in non attainment areas. Monitoring requirements will be necessary to identify "periods of noncompliance." Enforcement can include civil, as well as criminal penalties.

The 1990 CAAA established Federal requirements for BACT, RACT, BARCT, LAER. Local and Regional Districts are allowed to perform a structured process to construe what limits and technologies meet these categories, for various emission sources. District or State air quality attainment plans must be designed to achieve and maintain ambient air quality standards by the earliest practicable date, and include regulations which require control technologies for existing and new sources.

RACT is defined in 40 CFR section 51.100(o) as follows:

> "Reasonably Available Control Technology means devices, systems, process modifications, or other apparatus or techniques that are reasonably available taking into account (1) the necessity of imposing such controls in order to attain and maintain a national ambient air quality standard, (2) the social, environmental, and economic impact of such controls, and (3) alternative means of providing for attainment and maintenance of such standard..."

RACT is required in plans for all districts designated as "Moderate". RACT should be the most stringent of the following control options:

- The most effective emission limits in existing regulations that are currently in effect in any district whose non-attainment status is designated as moderate.
- Emission limits identified in existing Suggested Control Measures (SCMs), model rules, EPA's Control Techniques Guidelines (CTGs) or other such documents.
- The lowest emission limit that can be achieved by the specific source by the application of control technology taking into account environmental impacts, technological

feasibility, cost-effectiveness, and the specific design features or extent of necessary modifications to the source.
- The lowest emission limit achieved for the source category that is technically feasible, economically reasonable or achieved in practice anywhere (including outside of the U.S.).
- Any combination of control technologies that will achieve emission reductions equivalent to that resulting from the most stringent option listed above.

The application of BARCT (Best Available Retrofit Control Technology) will be required for districts that are designated as either "serious" or "severe". BARCT is generally defined as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source."

BARCT should be the most stringent and cost-effective of the following control options:

- The most effective limits in effect in any in the U.S., or in any other country for that source category.
- The most effective limit for a source category determined; to a reasonable degree of certainty, to be achievable in the near future.
- Any combination of control technologies that will achieve emission reductions equivalent to that resulting from the most stringent option listed.

The process of developing a definition for BARCT involves a structured process, including a "top down" cost effectiveness analysis for BARCT determinations. It is always preferred that the glass manufacturers actively participate in this defining process. All applicable control measures (i.e., add-on controls, process modifications, alternate fuels, etc.) for applicable source category (ies) are ranked from highest to lowest emission reduction of non-attainment pollutant (s). For the remaining control measures, a second ranking from best to worst cost-effectiveness is created.

CAAA 1996

On December 31, 2002 the US EPA published its final revisions to the New Source Review (NSR) programs mandated for both attainment and non-attainment areas. These revisions include Baseline Emissions Determinations, Actual to Future-Actual Methodology, Plant wide Applicability Limitations, and Pollution Control Projects.

Looking ahead, the Glass Industry's most viable option for long term compliance for strict NO_X limits will probably be conversion to 100% oxygen combustion. All glass industry segments have successfully converted to Oxy-Fuel. The implementation of this technology for meeting future environmental compliance will initiate a significant driving force to integrate waste heat recovery schemes - such as batch / cullet preheating, cogeneration, or gas reformer technology.

RECLAIM

The trading of emission reduction credits has been a reality for glass furnaces in the U.S. since 1994. The South Coast Air Quality Management District (SCAQMD) in Los Angeles developed a market based regulatory program called the Regional Clean Air Incentives Market (RECLAIM) program. Traditional regulations, known as command-and-control, had previously

set specific limits on each piece of equipment and each process that contributes to air pollution. RECLAIM encloses the facility in an imaginary "bubble." Rather than regulating each source, SCAQMD regulates the total pollution in the bubble, and lets businesses decide what equipment, processes and materials they will use to meet their emission limits. Under RECLAIM, these allowable emission limits decline a specific amount each year. Companies are free to choose the most cost-effective, economical ways to reduce pollution and operate within their allocation.

Participants in RECLAIM receive trading credits equal to its annual emissions limit. Credits are assigned based on past peak production and the requirements of existing rules and control measures. Credits are assigned each year and can be bought or sold for use within that year. Facilities must hold credits equal to their actual emissions.

The RECLAIM program applies to stationary sources that emit four or more tons per year from permitted equipment. It required industries and businesses to cut their emissions by a specific amount each year. The program targeted a 70% reduction for nitrogen oxides (NO_X) and a 60% reduction for sulfur oxides (SO_X)" over a nine year period. NO_X was included in the program because it is a precursor to ozone, for which the District is a Federal "extreme non-attainment" area. SO_X is included in the program because it is a precursor for fine particulate matter (PM_{10}), for which the Basin is in "serious" non-attainment.

Businesses that beat their reduction targets can trade their credits on the open market. Using market forces allows pollution to be cut in the most economical way. To monitor emissions at larger sources, RECLAIM requires use of continuous emission monitoring systems to determine actual mass emissions from these sources. These emissions are electronically reported to the District on a daily basis. The sale of credits by over control technologies (such as Oxy-gas for NO_X and scrubbers for SO_X) has yielded glass manufacturers significant revenues.

PSD / NSR

Under the original 1977 clean air act (40 CFR 52.21), Congress established Prevention of Significant Deterioration (PSD) program (applicable in areas attaining national ambient air quality standards) and non attainment New Source Review (NSR) program (applicable in areas not attaining such standards). "Major sources" and "major modifications" of criteria pollutants (O_3, SO_2, etc.) and "modifications" must be permitted under PSD and/or NSR programs

"Major modification" is defined as a "physical change or change in method of operation" of a major source that "would result in a significant net emissions increase" of any regulated pollutant. EPA's regulations include two significant exclusions from applicability: 1) activities that constitute "routine maintenance, repair and replacement" and 2) emissions increases attributable to an "increase in hours of operation or production rate".

If a physical or operational change constitutes a major modification, a source must install "Best Available Control Technology" (BACT) under PSD and "lowest achievable emission rate" (LAER) technology under non-attainment NSR; it also must comply with other requirements (including obtaining offsets for emissions increases in non-attainment areas)

EPA enforcement officials have concerns that some major facilities may have failed to comply with PSD/NSR permitting requirements since the enactment of these regulations. EPA is seeking installation of emission controls on sources which failed to obtain PSD/NSR pre

construction permits for "major modifications". Investigation begins with the issuance of "Section 114" request letters, followed by subsequent requests for information, inspections, and issuance of notices of violation (NOV's). Section 114 requests seek information on all plant changes since 1978 or 1980; but for the glass industry, the specific focus is on furnace rebuilds.

Under EPA's rules, activities that constitute "routine maintenance, repair and replacement" are excluded from the meaning of "physical change" and thus are exempted from NSR applicability. EPA has confirmed in the past that rebricking is routine for glass industry; e.g., in 1980 final NSPS preamble, EPA explained that "the rebricking exemption was not questioned due to the regularity and necessity of the operation to this industry;" in 1994 draft NSR rule preamble, EPA listed, as an illustration of routine maintenance, *"furnace refractory maintenance, repair or replacement with new refractory material at . . . glass facilities"*

EPA enforcement statements now indicate EPA's desire to limit scope of exclusion to "frequent, traditional and comparatively inexpensive" activities. EPA's current position seems to be that any repair or replacement activity that results in efficiency improvements or, even where it does not, that is not "comparatively inexpensive" does not come within the "routine" exclusion.

When furnace rebuild projects involves physical or operational change, the principal determinant in assessing NSR applicability is whether change results in a "net emissions increase". This is being defined as "any increase in actual emissions" from the change. Determining whether a net emissions increase occurs hinges on how post-change emissions are to be calculated.

EPA's NSR rules provide that "actual emissions" shall be equal to the "potential to emit" of a unit where, and only where, it "has not begun normal operations". EPA's methodology for determining "an increase in actual emissions" has changed dramatically over time. In early 1980's, after rule was promulgated, EPA recognized that it should compare pre-change to post-change actual emissions and only applied the "actual-to-potential" test where unit had truly not begun normal operations, i.e., there is no operating history. In late 1980's, EPA had begun to assert that "actual-to-potential" test generally should be applied.

In the future, EPA's enforcement initiative is likely to be a high priority. There is still uncertainty regarding the scope of the "routine" exclusion and how increases in "actual emissions" are to be determined. This uncertainty about PSD / NSR applicability may continue to lead some companies to enter into settlements with EPA.

CAIR BACKGROUND

On September 24, 1998, EPA finalized a rule (known as the NOx SIP Call) requiring 22 States and the District of Columbia to submit State implementation plans that address the regional transport of ground-level ozone. The intent of these plans is to decrease the transport of ozone across State boundaries in the Eastern half of the United States, particularly emissions of nitrogen oxides (a precursor to ozone formation). The NOx SIP call builds upon analyses conducted by the Ozone Transport Assessment Group (OTAG).

On March 10, 2005, EPA issued the Clean Air Interstate Rule (CAIR). The CAIR requires certain upwind States to reduce emissions of nitrogen oxides (NOx) and/or sulfur dioxide (SO_2) that significantly contribute to non attainment of, or interfere with maintenance by, downwind

States with respect to the fine particle and/or 8-hour ozone national ambient air quality standards (NAAQS). The CAIR requires these upwind States to revise their State implementation plans (SIPs) to include control measures to reduce emissions of SO_2 and/or NOx. Sulfur dioxide is a precursor to $PM_{2.5}$ formation and NOx is a precursor to $PM_{2.5}$ and ozone formation.

On May 12, 2005, the EPA published the final "Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone" (Clean Air Interstate Rule or CAIR) (70 FR 25162). In this action, EPA found that 28 States and the District of Columbia contribute significantly to non attainment of, and interfere with maintenance by, downwind States with respect to the NAAQS for fine particles ($PM_{2.5}$) and/or 8-hour ozone.

The EPA conducted extensive air modeling to determine the extent to which emissions from certain upwind States were impacting downwind non attainment areas. All States found to contribute significantly to downwind $PM_{2.5}$ non attainment are included in the CAIR region for $PM_{2.5}$ and are required to reduce annual emissions of SO_2 and NOx. All States found to contribute significantly to downwind 8-hour ozone non attainment are included in the CAIR region for ozone and are required to reduce NOx emissions during the 5-month ozone season (May-September).

The first phase of NOx reductions starts in 2009 (covering 2009-2014) and the first phase of SO_2 reductions starts in 2010 (covering 2010-2014). The second phase of both SO_2 and NOx reductions starts in 2015 (covering 2015 and thereafter). Each State covered by CAIR may independently determine which emission sources to control, and which control measures to adopt.

OTC BACKGROUND

The (OTC) is a multi-state organization created under the Clean Air Act (CAA). Their responsibility includes advising EPA on transport issues and for developing and implementing regional solutions to the ground-level ozone problem in the Northeast and Mid-Atlantic regions. OTC members include: Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.

The Coalition of Northeastern Governors (CONEG) believes that particular attention must be paid to improving air quality to protect public health and the environment, equitable environmental requirements should apply across the country, and one region should not adversely impact another. CONEG supports the ongoing efforts of the Ozone Transport Assessment Group (OTAG).

Because ambient air quality in this region is often influenced by emissions from "upwind" states, the Commission believes Model Rules must be developed and implemented for the entire Region. The Committee has compiled a list of Reasonably Available Control Technology (RACT) Control Technique Guidelines (CTGs) categories that should be updated. The OTC Model Rules have been recommended as a logical starting point for RACT updates for State adoption in future rule making.

The OTC's Control Strategy Committee has recommended NO_X control measures for 33 industrial processes, including Glass. These recommendations are in final draft form, and the

last opportunity for modifications will be by written submission to OTC or during comment periods at their next meeting (Nov. 15, 2006). At this meeting the Commission expects to approve the model control measures and recommend their member states to adopt them into new emission regulations.

The driver for these model rules are ambient air computer models showing that there must be significant reductions of existing emission inventories to meet Clean Air Act standards. To accomplish this, OTC is using BACT criteria for selecting technologies which have the highest percentage of reduction and have cost effectiveness numbers no greater than ~ $2,500 per ton of NO_X reduced. CEMS will be required for compliance assurance.

The Glass Furnace NO_X emission inventory in the OTC Region is currently estimated to be approximately 15,000 tons per year (~ 5 % of the total emissions inventory). At the time of this writing, the OTC is considering a change from their Model Rule requiring Oxy-Fuel melting, to an emission limit rule - similar to the SJVUAPCD Rule 4354. Such a rule would reduce glass furnace emissions by ~ 44 %.

A very strong message coming out of the OTC region is that the Federal EPA needs to revise emission limits on a broader (national) basis, such as what is being done under CAIR for Electrical Generating Units (EGU's). Many regional ambient air quality problems are affected from "up wind" sources out of their regulatory authority.

OSHA ISSUES ON HEXAVALENT CHROMIUM

In April 2003, a U.S. Court of Appeals ordered the Occupational Safety and Health Administration (OSHA) to promulgate a standard governing workplace exposure to hexavalent chromium. OSHA has published a final standard for occupational exposure to hexavalent chromium in the Feb. 28, 2006, Federal Register.

The new standard lowered OSHA's permissible exposure limit (PEL) for hexavalent chromium, and for all Cr (VI) compounds, from 52 to 5 micrograms of Cr (VI) per cubic meter of air as an 8-hour time- weighted average. The standard also includes provisions relating to preferred methods for controlling exposure, respiratory protection, protective work clothing and equipment, hygiene areas and practices, medical surveillance, hazard communication and record keeping.

Glass manufacturers have an obligation to measure the level of hexavalent chromium in all areas of their facilities which could expose their employees to excessive levels. Sources of hexavalent chromium can include exhaust gases from furnaces or forehearths utilizing Chrome containing refractories, Chrome containing glass colorants, or operations where hexavalent chromium may be volatilized (such as color and traditional forehearths). Engineering controls will be preferred over personal respirator equipment.

FUTURE ISSUES

Since 1990, additional regulations have been applied to "toxic" particulate - particularly Lead and other heavy metals (Arsenic, Selenium, Cadmium and Chrome compounds). At the time of this presentation in 2006, there are continuing regulatory initiatives to further limit emissions from glass melting furnaces.

The Clean Air Aet Amendment requires the EPA to address the reduction of Urban Air Toxics. Section 112(b) lists 189 Air HAP's, but 33 specific Urban HAP's (the "dirty thirty") are to be specifically addressed in new Area Source Standard regulations for the emitting industries. Their authority for these actions come from the CAA's Sections 112(c)(3) and 112 (k)(3). Facilities which include toxic compounds among raw materials for glass melting will be subject to the new standards. Seventy area source categories have been listed for standards development. Standards for 15 are complete, 5 have consent decree dates for promulgation, and 50 are subject to ongoing negotiation to establish consent decree dates.

Specific materials potentially subject to the new regulations for glass include compounds of Arsenic, Cadmium, Chromium, Lead, Manganese, Mercury, and Nickel. Area source standards are to be technology-based and capable of reducing emissions by ~ 90 %. EPA currently is planning to propose an equipment standard. EPA is considering requirements to properly install, maintain, monitor and keep records on the performance of air pollution control devices on the processes subject to the regulation. EPA is currently considering emission controls on raw material handling and processing lines and on furnaces. There could also be consideration for controls if Chrome containing refractories are used in the furnace.

Section 112 of the Clean Air Act (CAA) requires the development of standards for area sources which account for 90% of the emissions in urban areas of the 33 urban hazardous air pollutants (HAP) listed in the Integrated Urban Air Toxics Strategy. At this time the EPA is attempting to quantify the extent of potential emissions of HAP's from Glass manufacturing. They have been using existing Permits, State Inventories and the federal Toxic Release Inventory (TRI). To date they have values for ~ 170 facilities, but believe there are as many as 500 glass related sources.

A recent Draft by EPA for National Emission Standards for Hazardous Air Pollutants (NESHAP) will require reporting by glass manufacturers as to the weight of "hazardous" materials in their batch. If the level exceeds 1% of the batch weight or use exceeds 20 tons / year, stack source tests will be required to quantify the level of emissions. If defined levels are exceed, the use add on controls such as a bag house or an electrostatic precipitator (ESP) will be required.

EPA's greatest concern seems to be with the use of Arsenic, and other colorants used in the Press & Blown and tableware industry (Cadmium, Lead, and Antimony). For container glass, the major issue will involve colorants (Selenium, Chromium, Nickel, Cobalt). To date, EPA has found limited contacts in industry to discuss these issued.

GREENHOUSE GAS ISSUES

Similar to European initiatives, CO_2 emissions may well be Federally regulated under pressure from "Global Warming" concerns. On August 31, 2006, California's legislature approved the

broadest restrictions on carbon dioxide emissions in the nation. The California bill requires a 25 percent cut in carbon dioxide pollution produced within the state's borders by 2020 in order to bring the total down to 1990 levels. In at least eight other states, political momentum is building to take similar steps to limit emissions of greenhouse gases linked to climate change, a trend that could increase the pressure for a national system.

The California legislation also provides a statewide market system designed to make it easier for heavily polluting industries to meet the new limits. They would be able to buy "credits" from companies that emit lower emissions than the caps allow, rather than having to invest in lower greenhouse gas emitting technologies.

It is still unclear how this legislation will effect the glass industry, CO_2 emissions from glass melting include the results of natural gas combustion, as well as evolution from raw material Carbonates. For Soda-Lime glasses, there are typically more than 35 tons of CO_2 emitted per 100 tons of glass melted. Recycling of 6 tons of cullet reduces 1 ton of CO_2.

CONCLUSIONS

- Regulations will continue to become more stringent in Non-attainment Regions
- Agencies will expect newer technologies to be more efficient than what are currently available
- Future furnace Types and Designs will give greater consideration for emission compliance
- Compliance will have higher priorities in operations
- More CEMS will be required for Compliance Assurance
- New Source Requirements will become more stringent