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A Practical Approach to Biomass Firing

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ere are many challenges in power generation today. Amongst them are:

- Currently lower natural gas prices - uncertain natural gas prices in the future
- Reduction of carbon emissions
- Swinging large coal unit loads down to low loads at night to accommodate alternative generation and the declining industrial sector load (traditionally base load demand)
- Public & government pressure to fire more renewable fuels
- Keeping America strong with reliable, reasonable cost electricity generated from fuels sourced from within our borders

hese challenges force plants to utilize renewable fuels such as biomass, here are ee suggestions to make the best of what we have in installed capacity with ever ore difficult regulations:

1. Add high turn-down burners that use wood waste or other renewable fuels for low load operation at night. This is an idea that can be implemented at a reasonable cost and can help meet the requirements to fire alternative fuels, including biomass.
2. Improve heat rates by reducing air in-leakage and improving air pre-heater performance.
3. Establish a performance preservation program to work toward performance driven maintenance.

ere are two reasons for item No.1 – retrofitting with high turn-down burners:

1. With the economic recession, low gas prices and reduced industrial production, the system loads for many utilities and IPP's require deeper load swings at night due to less base load industrial demand and a larger portion of electrical

Things to Consider in Co-firin with Biomass

It seems that every day we hear more a more about "biomass" and renewable fuels. Environmental groups and many politicians are advocating the use of biomass. So let us take a few moments and discuss biomass and why it should considered and what the advantages an disadvantages are:

First, biomass fuels are fuels derived from living (or once living) organisms such as wood, waste and alcohol. Thes fuels are used to generate electricity or heat. While traditional fossil fuels are also derived from organic matter, they are not considered renewable due to the geologic process in converting the matt to coal or oil. Next, you might be thinking, why should we use biomass fuels? There are several advantages:

- Biomass fuels produce virtuall no sulfur emissions and requir no scrubbers or reagents to hel mitigate acid rain.
- Biomass fuels "recycle" atmospheric carbon, minimizi manmade carbon dioxide emissions since zero "net" carbon dioxide is considered emitted during biomass combustion, i.e. the amount of carbon dioxide emitted is equa to the amount absorbed from t atmosphere during the biomas

demand being from residential and commercial customers. The reduced nighttime demand is compounded by presently low natural gas prices. Therefore, the ability to turn large coal units down to lower loads and keep the "spinning reserves" of large coal units is important.

2. It appears that further laws and pressure to burn more renewable fuels is a reality. So, if we have to burn waste wood, chicken litter or other alternative fuels, why not do it in hybrid burners at night at low loads when the furnace residence time is greatest?

ere is an option on how a unit can be retrofitted at a reasonable cost. Please see gure 1 - a typical pulverized coal fueled utility boiler retrofitted for hybrid fuels pability:

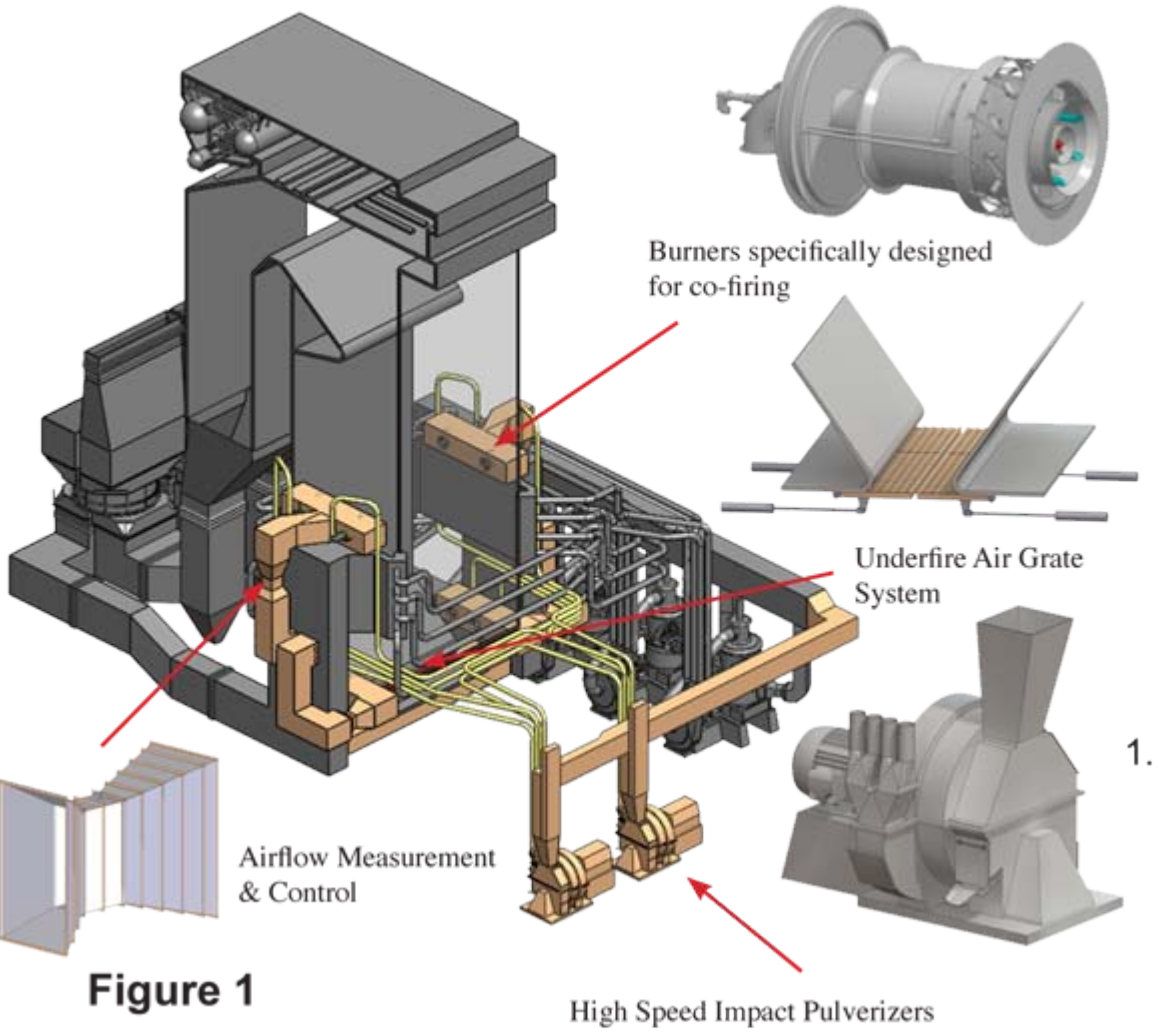

Figure 1

1.

ere are four reasons why we think retrofitting large pulverized coal boilers for firing

growth phase.

- The recycling of biomass wast mitigates the need to create ne landfills and extends the life o existing landfills.
- Biomass combustion produces less ash than coal and reduces ash disposal costs and landfill space requirements. Biomass ash when fired alone can also used as a soil amendment in farm land.
- Perennial energy crops (grasse and trees) have distinctly lowe environmental impacts than conventional farm crops. Ener crops require less fertilization and herbicides and provide greater vegetative cover throughout the year, providing protection against soil erosion and watershed quality deterioration, as well as improved wildlife cover.
- Landfill gas-to-energy projects turn methane emissions from landfills into useful energy.

All of this sounds good, but like most things in life, there are some disadvantages too. They include:

- Lower heating value and high moisture result in high consumption rates, which increase material handling.
- Obtaining a reliable supply chain to replace a significant amount of coal will be difficul It takes about six rail cars of biomass to replace the equivalent of one rail car of co energy.
- Although considered carbon neutral, biomass still produces carbon dioxide and other greenhouse gases and will bur at lower efficiency due to the moisture content.
- It takes up more water from th earth and other fossil fuels to make the fertilizers and fuels f planting and harvesting.
- It also will take up more land

omass is a practical concept:

1. Approximately 72% of the total electricity in America is generated by thermal power generation of coal, natural gas and oil fuels. Using biomass in a thermal plant utilizes existing steam plant installed capacity.
2. Of the approx. 72% thermal electricity production, approx. 50% is generated by coal. Therefore, a great opportunity exists to utilize our existing power generating infrastructure for firing alternative fuels. (coal plant installed capacity about 335,000 Megawatts and the grid is already built to distribute power from these about 570 plants)
3. The average age of pulverized coal plants is over 35 years old, but they are proven to be reliable, rugged and capable of extended life making retrofitting a cost efficient option.
4. While addressing the hybrid alternative fuels concept, the operation during off peak periods can be designed to utilize stable, low load gas burners and smaller capacity pulverizers at lower loads (Figure 1).

egardless of the fuel fired, firing it well should be our top priority. Please let us know you would like more information on retrofitting your boiler for biomass fuels. And en if this is not an option for your plant, we would still love the opportunity to discuss r heat rate improvement and performance driven maintenance programs with you.

ncerely,

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second major energy transition originated in the United States. In the mid nineteenth ntury, petroleum was first used as a substitute for whale oil for illumination in the m of kerosene. At the beginning of the twentieth-century, coal still accounted for ore than 93% of all mineral fuels consumed in the United States, and electric light as rapidly displacing the kerosene lantern in urban America, with eighteen million htbulbs in use in 1902. Large oil fields were discovered in Texas and California early the century. Railroads in the west and southwest almost immediately converted to oil rning, because local oil was cheaper than distant coal when transportation costs ere figured in.That conversion prepared the way for the use of gasoline in tomobiles."

ere is a short math exercise: If tree farms can produce an average of 10 tons of ood per year per acre, then how many acres will it take to replace 200,000,000 tons coal per year? (A little less than 20% of our coal production in America of about

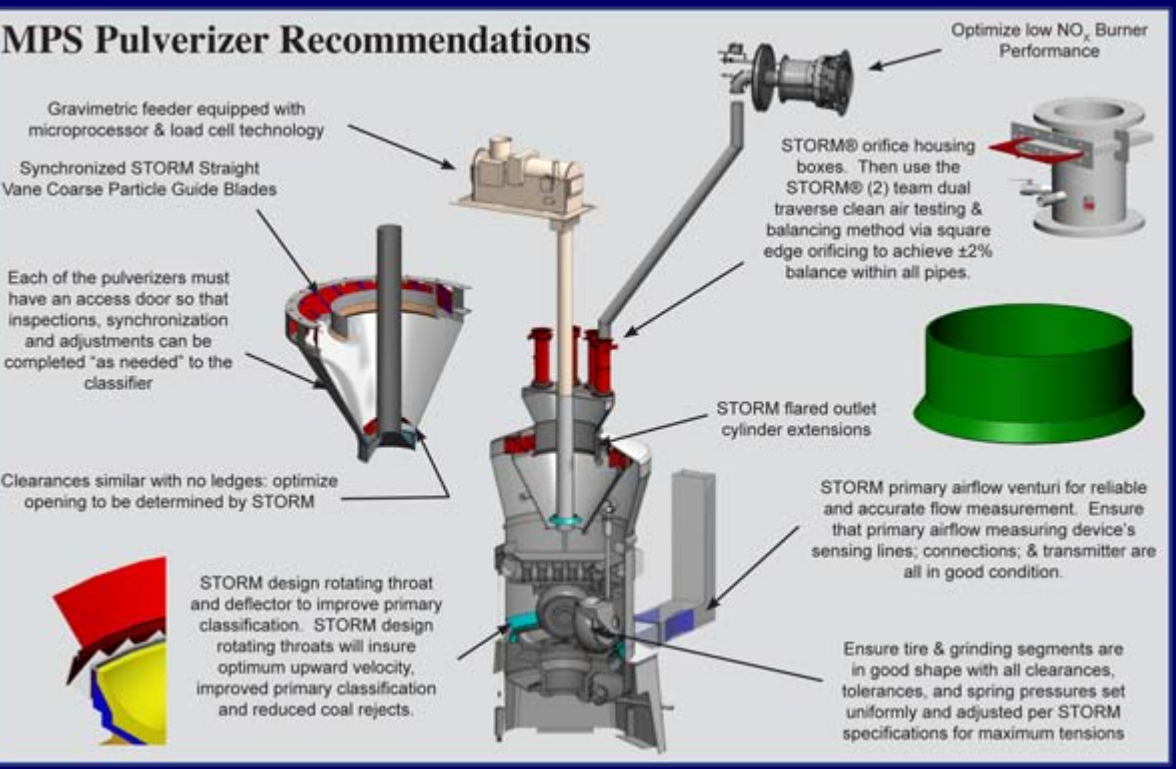
that could have been used for crops and trees.
- Biomass collection, storage an treatment are difficult.
- It can lower the efficiency of boilers when it is used by plan which mix it with other combustible materials.
- It requires a large space to be stored correctly.
- Biomass if used in large quantities from forest products will likely increase timber and wood pulp costs just as ethano production increased corn prices, therefore harming the economy for building and pap products.

After weighing the pros and the cons, if your facility decides to use biomass by co-firing (blending the fuels with the co at the coal-fired boilers), you must remember this key point about co-firing biomass: co-firing operations are not implemented to save energy; they are implemented to comply with renewable power standards and federal or state regulations, not to reduce energy costs to improve facility operations. Reduced production costs from co-firing biomass are unlikely; reduced fuel costs may be possible in some localities by (1) replacing a fraction of higher-cost fuels with low-cost biomass and (2) reduced disposal costs. When used as a supplemental fuel in an existing coal boiler, biomass may provide some benefit such as reduced fuels costs, low sulfur oxide (SO_X) and nitrogen oxide (NO_X) emissions, lower landfill costs a reduced greenhouse-gas emissions.

However, the realities are that productio and operations and maintenance costs will increase with the use of biomass. F example, there are some disadvantages with slagging, fouling and corrosion being the most noticeable ones. A number of biomass fuels have high alka and/or chlorine content. This combination can lead to unmanageable ash deposition problems on the heat exchange surfaces. Moreover, chlorine

100,000,000 tons per year) Two more thoughts; remember that biomass is much ss dense than coal (wood chips about 18 pounds per cubic foot) and much less ating value per pound (wood is generally accepted to be about 8,500 Btu's per und ovendry and below 5,000 Btu's per pound with high moisture content). Hint, ke a look back into history such as the 19th century energy use and then factor in our ergy consumption for transportation needs to keep our economy humming and also ving Better Electrically" to today's standards of living.

the retrofitting of alternative fuels could be linked to the removal of New Source Review NSR) restrictions, then it would seem that all sides of the issue could be satisfied. Alternative els could be used while existing plants would have the freedom to install new boiler rfaces, correct casing leaks and install new upgraded airheaters and other plant nprovements. Imagine what we could do for lowering the costs of electric power production ere it not for NSR? This could really make a difference and I think a large number of us riting Congress could persuade some common sense to prevail. Inspire your friends and ighbors to write your congressmen to abolish New Source Review.



in combustion gases can accelerate corrosion of combustion systems and flue-gas cleaning components. Similarl NO_X emissions may be increased with co-firing due to the increased furnace excess oxygen content needed to complete the burning of larger fuel particles in the available residence time

In addition, there will have to be chang to the process. Certain equipment will have to be retrofitted to handle the biomass fuels (such as the concept sho in Figure 1). One cannot just "throw in some wood chips or chicken litter in the pulverizer and expect everything to work. Modifications to the equipment and process will have to be implemente in order to maximize fuel handling efficiency and the effectiveness of combustion. Essentially, the process wi need to change so that the limited available residence time is used to combust slower burning and larger particles of fuel.

Another issue that can have a negative economic effect on the facility is the as markets. Concrete admixtures represen an important market for some compani considering the combustion ash by-products. Current ASTM standards for concrete admixtures require that the ash be 100% coal ash. Thus, the conversion/addition of biomass can hav serious impact on the ability to utilize flyash for construction. This can have a very negative impact on coal ash utilization and the ability to sell coal as

Finally, there are logistical and storage considerations. Biomass is larger (greater volume per cubic foot) than co for an equivalent amount of heat energy Thus, it will take more storage space. I addition, because biomass absorbs mor water than coal, the fuel will have to be covered. Moreover, since some biomas fuels are reactive, fire suppression systems may need to be upgraded.

So, the $64,000 question (really it's a l more than that) is should your facility implement co-firing of biomass? There

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are many facilities that have implemented co-firing with biomass an increased profitability. The answer depends on the details. If you expect th co-firing to lower your production costs then think again. However, if all of the costs of co-firing biomass are understood, then it is worth considering

The concept outlined in this newsletter one way to co-fire biomass in existing boilers designed and proven to fire pulverized coal very efficiently and effectively.

Regardless, there is a movement by the press and the public to use more renewable fuels. You may be able to score a few points in the public relation battle and still produce electricity at competitive rates. When competing with high cost solar, wind and other renewables, co-firing biomass could be more economically feasible than other alternative fuels. Biomass is likely to be significantly more costly than coal as a fuel.

Just as there is no free lunch, biomass electricity production will cost more tha power from traditional fossil fuels. Our experience in furnace combustion includes years of working with wood waste and bark fueled boilers in the pul and paper industry as well as boilers firing municipal solid waste. So, our experience in biomass firing can be tapped to combine with your engineerin department expertise.

At Storm Technologies, we can assist you in making changes to your facilitie to implement co-firing with biomass fuels.

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