# Lextran Solution for Small Boilers and Waste Incineration Units

USEPA estimates that in United States only there are about 13,800 boilers located at large sources of air pollutants, including refineries, chemical plants, and other industrial facilities. There are about 187,000 boilers located at small sources of air pollutants. The emissions volumes vary from source to source, but in the end of the day we find ourselves surrounded by them. The "small sources" include universities, hospitals, hotels and commercial buildings[1]. So our young and sick are constantly poisoned, we are breathing the toxins at work and even when we get to relax at some resort we are suffocated by the invisible "assassins".

*Figure 1. Lanzhou (Gansu Province) on a bad day*

In China, the largest $SO_2$ polluter in the world, the industrial (non power-plant) and domestic sources are responsible for almost a half of the total $SO_x$ [2], $NO_x$ and heavy metals emission. Almost half a million of Chinese citizens die prematurely as a consequence of air pollution[3]. The danger in having those polluters in the midst of the population is evident and the Beijing municipal government recently published a plan to remove or upgrade more than 500 heating boilers in the next five years[4].

Hundreds of thousands of coal and municipal waste fired units with installed capacities less than 100 MWe are currently operating in the USA (*Figure 2*)[5], China and India without NOx, SOx, or mercury control. These smaller units are a valuable part of the power and heat generation infrastructure, part of basic industrial processes contributing to the economy and the welfare of citizens. However, with ever tightening emissions requirements (eg. CAIR, CAVR, MACT standards and other national environmental protection regulations), pollution control equipment will be required in many cases to allow these units to keep operating.

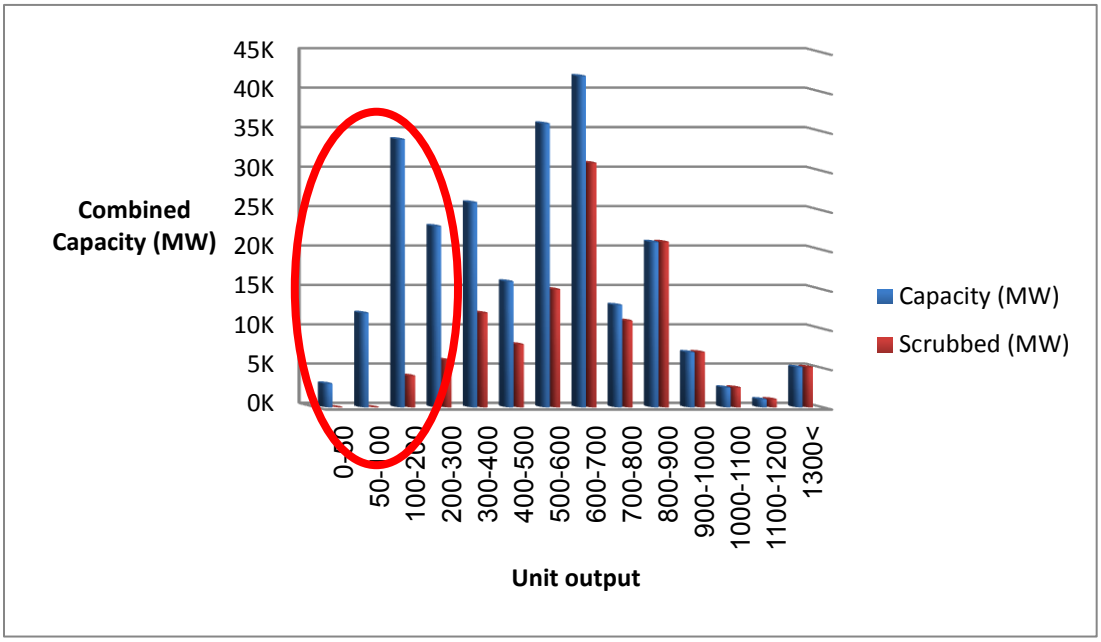


*Figure 2. Scrubbed and Unscrubbed boilers in the US. URS data (2011).*

The most widely used and available FGD technology is the lime-FGD. However, while lime-FGD systems are the prevailing solution, technologically and environmentally it is outdated. Generally, smaller boilers (under 300 MW) have been also shown to be significantly more expensive to retrofit with wet scrubbers (capital cost normalized to a $/KW basis) than larger boilers due to economies of scale. The economies of scale become less significant as boiler size increases[6].

Water pollution is considered at least as disastrous as the air pollution thus governments are also tightening surface water discharge limits. The majority of EU countries classify the sludge water as an environmental hazard which has to be treated prior to discharge into the water bodies[7]. As a result, utilities considering installation of Wet FGD must also invest in the associated wastewater treatment systems.

The de-$NO_x$ technologies are not in a better state. The current SCR systems suffer from several inherent disadvantages, such as: high CapEx, $SO_2$ oxidation, honeycombs clogging and others.

Further on the large capital and space requirements should be considered. At present, lime–FGD requires investment in the lime stone storage facilities, processing areas, gypsum post processing and loading facilities, access roads and the many acres required to construct those. The SCR system alone demands yet another space consuming construction, and yearly procurement or regeneration of considerable amount of catalyst.

Conventional pollutant control systems do not provide the solution the industry is so desperately seeking. Operators of small boilers already installed in the dense industrial and

urban areas cannot bear the burden of heavy capital and operational expenditures. The profitability of operating the boilers drops dramatically!

### Lextran's Innovative de-SNOx Alternative

The future of the Air Pollution Control lies in new revolutionary technologies. The solutions must address three needs: cost effective hazardous air pollutants removal, small environmental footprint and an answer to further regulations tightening.

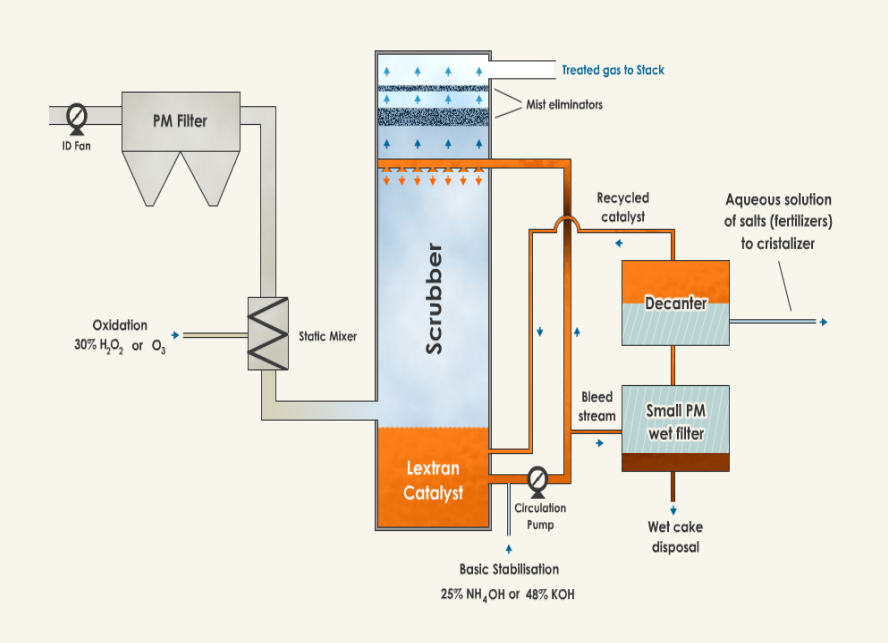


*Figure 4. Schematic design of Lextran's WFGD-based operation. Removes $NO_x$ and $SO_x$ from flue gas and convert them into fertilizers.*

For the smaller units the large capital and space requirements add another dimension to demands from emissions control technologies and a multi-pollutant approach (i.e. installation of a combination of technologies in an integrated and innovative way) is the most appropriate.

Lextran has developed a unique catalyst and process to be used in **one open spray tower** that meets all the requirements. This state of the art process offers comprehensive technological, financially beneficial and environmentally friendly solution. A gas-liquid contacting absorption tower (scrubber) is constructed to disperse the Lextran reagent. Lextran technology proves to be inherently **less demanding in space, infrastructure and auxiliary components** compared to conventional Flue Gas Treatment solutions.

Lextran technology enables the absorption of the following pollutants from flue gases in <u>one single pass</u>:

Sulfur oxides ($SO_x$) - **removal of 99%, unconditional of entrance concentration.**

Nitrogen oxides ($NO_x$) - **removal of up to 90% of entrance concentration.**

This approach is especially appealing for plants with small units that must balance upgrading pollution control equipment with justifying high capital expenditures. Integrating the two

processes (FGD scrubber, SCR or SNCR) into one structure provides significant cost savings over treating the units separately, and optimizes the use of space.

The Lextran product, manufactures by a proprietary nanotechnology based process, contains an active sulfur-oxygen functional group, having catalytic properties which enhance the oxidation reactions of $SO_x$ and $NO_x$ into $SO_4$ and $NO_3$ anions. Once a basic reagent (ammonia or KOH) is added to stabilize a byproduct that is typically a fertilizer the catalyst ends its role and is returned back into the scrubbing tower.

**Economical potential and cost-efficiency**

After facilitating the initial oxidation, the Lextran catalyst is released and recycled back into the process leaving the pollutants in chemical form amenable to become commercially beneficial by-products (Fertilizers) with a further neutralization by ammonia, KOH, or other basic reagents to control the type of byproduct. The possible byproducts are therefore highly economically potent ammonium nitrate, ammonium sulfate, potassium sulfate, potassium nitrate, and others.

With roughly 60% of overall cost of building a new WFGD facility and de-$NO_x$ equipment and less than 30% of the running costs, Lextran multi pollutant process introduces a dramatic saving compared to traditional dedicated facilities which have to be implemented sequentially.

**Bottom line – cost saving of at least 30% in construction, and 60% in operational costs.**

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[1] Mustian M. A.," USEPA Issues Final Boiler MACT Rules", available at: http://www.environmentallawresource.com/2011/03/articles/air/usepa-issues-final-boiler-mact-rules/

[2] Lu Z. et al, "Sulfur Dioxide Emissions in China and Sulfur Trends in East Asia Since 2000", *Atmospheric Chemistry and Physics*, vol. 10 (2010), pp. 6311-6331

[3] Bradsher K. and Barboza D. , "Pollution From Chinese Coal Casts a Global Shadow", *The New York Times*, June 11, 2006

[4] Peoples Daily Online, "Beijing to Launch Clean Air Action Plan" April 19th, 2011, available at: http://english.peopledaily.com.cn/90001/90776/90882/7354823.html

[5] Based on the data presented by Gordon Maller (URS) on September 15th, 2011 at "2011 WPCA IL Regional Technical Seminar".

[6] Sharp G.W., "Update: What's That Scrubber Going to Cost?", *Power*, (March 1, 2009), available at: http://www.powermag.com/issues/features/Update-Whats-That-Scrubber-Going-to-Cost_1743.html

[7] Kikuchi R.," Alternative By-Products of Coal Combustion and Simultaneous $SO_2/SO_3/NO_x$ Treatment of Coal-Fired Flue Gas: Approach to Environmentally Friendly Use of Low-Rank Coal", in Kenneth S. Sajwan et al. ed., *Coal Combustion Byproducts and Environmental Issues*, (New York: Springer, 2006), pp.23-24