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FLUE GAS TREATMENT AND FERTILIZER CO- PRODUCTION BY CLEANER TECHNOLOGY

(This is a TUBITAK TEYDEB and TAGEM project. Patent Protected)

OBJECTIVES OF THE PROJECT

This project involves a clean technology that aims to treat air pollutants SOx (sulfur oxides), NOx (nitrogen oxides), COx (carbon monoxide / dioxide), PM (particulate matter), VOCs (Volatile organic compounds) from the flue gas of a combustion unit, while producing fertilizer. Patented technology has several benefits compared to conventional treatment systems and newly developing de SONOX systems.

- This once through absorption system does not create waste heaps like conventional desulphurisation systems. Furthermore, clogging is far less likely, energy use is much less than a conventional slack lime scrubbing system.
- Large areas are required for raw material and waste of FDG systems. Here land requirement is minimized due to simple design.
- Odour problem is minimised.
- More substances are recovered compared to conventional techniques and other new technologies. Especially CO_2 capture is an important added value.
- Waste is avoided because all of the recovered substances are converted to inorganic fertilizers. Fertilizer quality has already been tested and licensed by the Ministry of Agriculture.

How the system functions:

Developed system is a patented once through counter flow wet scrubber. Flue gas passes through the scrubber column. An aqueous solution of zeolite and ammonia is sprinkled from the top of the column (See figures 1 and 2). Clean gas leaves the system from the top of the column. Remaining solution with the adsorbed substances is sent to storage for drying and use as fertiliser. Residue is utilised as fertiliser (fertiliser compliance tests have been conducted and license was issued). Composition is ammonium sulphate, ammonium nitrate and ammonium bi-carbonate. Fertiliser produced can be used directly and both as liquid and solid composition. The process becomes stable within 2 minutes at start.

Depending on the conditions, removal rates may vary. Achieved removal rates are laid down in the table below. Optimisation studies for increasing the removal efficiencies are being carried out. Figures and estimates are obtained from pilot application at a 300kW coal boiler.

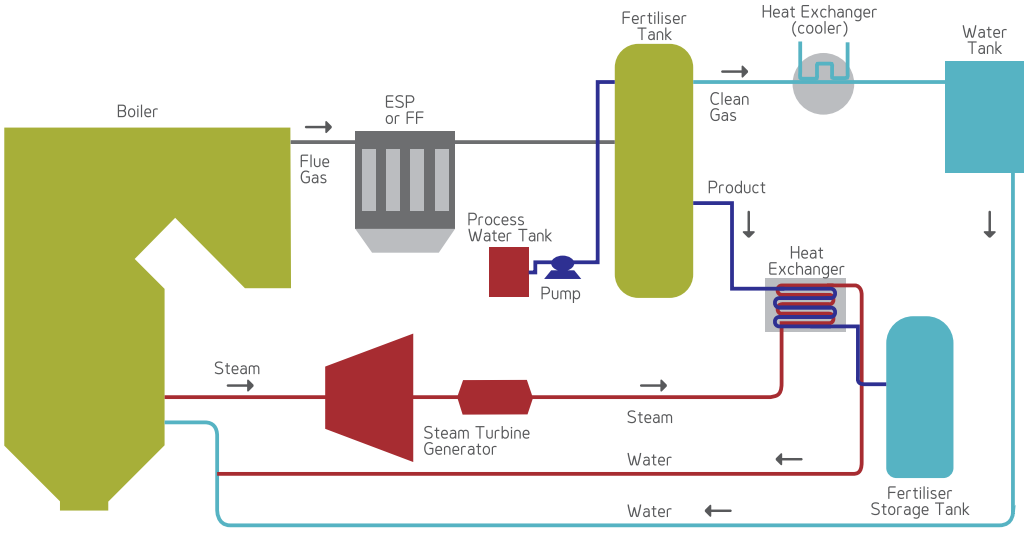
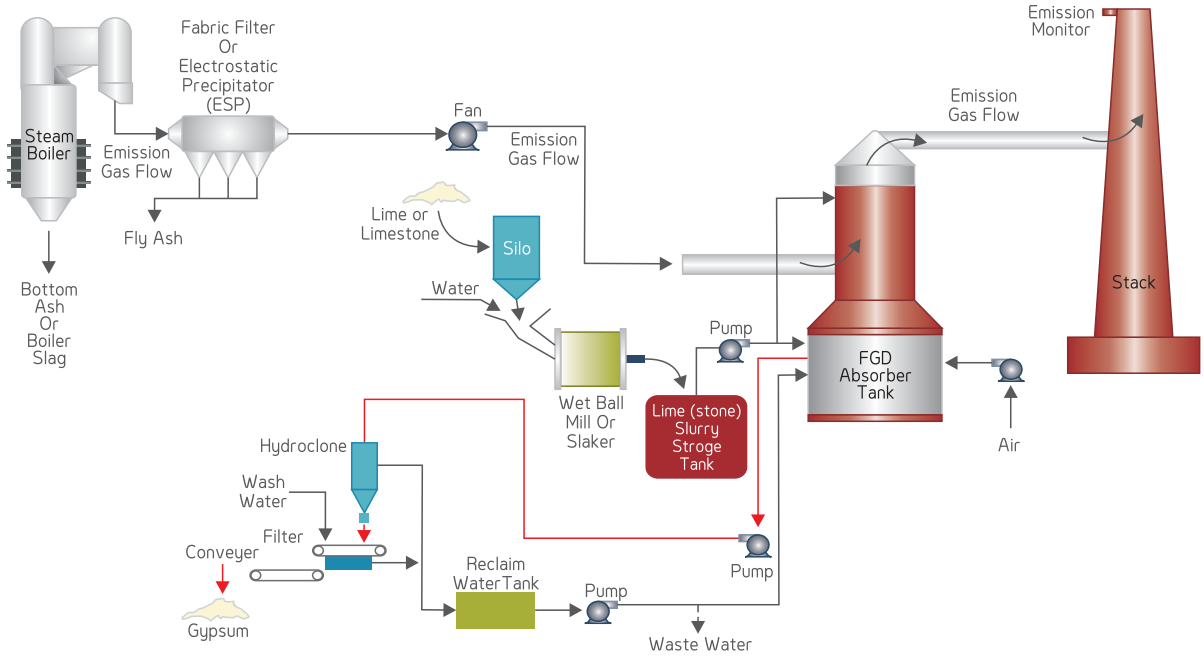


Figure 1. Process flow diagram with auxiliaries

Lime (Stone) Forced Oxidation Wet Flue Gas DesulfurizationProcess



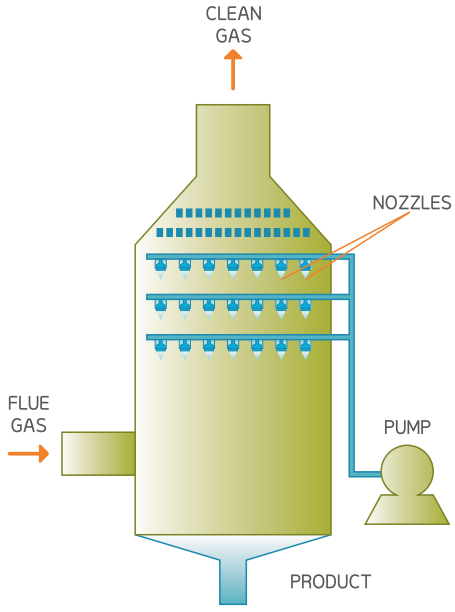


Figure 2 . Scrubber column

Treatment performance results (reduction rates) during pilot study with single column:

Parameter	Reduction rate (%)
SO_2 (sulfur dioxide)	98 %
NOx (Nitrogen mono/dioxide)	70 %
COx (carbon mono/dioxide)	70 %
Fly ash	65 %
VOC (21 varieties)	15-65 %
Water saving	80 %
Energy saving	15-20 %

OUR WORK IS WITHIN THE SCOPE OF RENEWABLE ENERGY

Carbon Capture

The system addresses CO and CO_2 issues that have recently gained interest. COx gases are converted into ammonium bicarbonate and directly used as fertiliser. During pilot scale studies, 70% COx reduction was achieved. This will contribute achieve greenhouse gas reduction targets and help combat against global warming.

Recently, global warming has proven scarier than most of the scenarios and urges for further efforts for mitigation and adaptation. Carbon capture technologies are sought desperately. The newly developed technology provides a promising alternative to other carbon capture technologies. This is now more important than ever.

This year in November and December, Climate summit will be held in Paris. 35 billion tons CO_2 reduction is targeted. 40% reduction by 2030 and 70% reduction by 2070 is targeted by UN. 2070 target could already be achieved by HAK2 capture technology.

Also provides an opportunity for carbon emissions trading.

Inorganic fertilizer instead of waste

- The residue obtained at the bottom of the column can be used as fertilizer (consisting of sulphates, nitrates and carbonates, depending on the treatment system design) either as liquid or solid. In case of solid use need, the waste heat can be used as a direct dryer. This option also creates an energy saving opportunity.
- The fertilizer has been tested for:
  - Ingredients
  - Metals content
  - Plant growth stimulating potential

- The fertilizer is licensed in HAK2 brand. Minerals used in the absorbent solution provides best circumstances for the fertilizer. Such that:
  - Provides slow and timely release while avoiding rapid washing by rain or irrigation water.
  - Acts as soil conditioner with additional high water absorbing capacity and does not allow rapid water transfer to deeper soil.
  - The fertilizer is comparable to other conventional fertilizers, but with five times lower costs.
  - There is a demand for fertilizers, with fluctuating rates and costs; with the help of this operation, need for chemical fertilizer production will decrease, reducing also total pollutant emissions. This is a multiplication effect on environmental benefit.

Other economic, social and environmental benefits:

Large combustion plants are in focus of high technology environmental pollution reduction systems. Smaller combustion units, due to lower capacities and higher unit costs (scale factor) and lower focus on pollution blame, are either underestimated or ignored, or less required to abate pollution because of higher relative costs. By the help of this technology, cost effective emissions reduction will be possible. Further emissions control on small and medium sized installations will provide more reduction in overall emissions.

Further improvement in environmental health will be achieved.

While 8 most developed country have made a joint decision to reduce and stop coal fired combustion plants, this is a slow and time-taking process. There is still considerable share of coal and lignite on energy production. Although share of renewable sources are increasing, they also have certain adverse impacts on environment; hence, fossil fuels are likely to be around for quite some time. Effective implementation of this technology will improve cleaner use of those fuels, with positive side effects.

Farmers will benefit the organo-mineral fertilizer with soil enhancing effects and lower costs.

Mineral content of the HAK2 fertilizer will help rehabilitate deteriorated soils, abating agricultural land loss.

There are other sources of CO_2, especially industrial facilities like cement and lime production, geothermal heat and power facilities, etc. They are not fossil fuel related, but arise from the chemical conversion, or naturally occur. HAK2 technology can also be utilised at these sources to capture CO_2 emissions.

It has recently been understood that existing efforts and scenarios are not sufficient to combat against global climate change. More measures are needed to reduce greenhouse gas emissions. While there are several efforts discussed, negotiations and effective implementation is undermined by economical reasons. The newly developed technology will provide a cost effective solution to greenhouse gas reduction and contribute the combat against climate change.

Project Team

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RESEARCH AND DEVELOPMENT OF THE FLUE GAS TREATMENT WASTE AS FERTILIZER AVAILABILITY

ABSTRACT: This Project was implemented with the aim of NOx (Nitrogen Oxide) SOx (Sulphur Oxide), COx (Carbon Oxide) etc. Chimney gases that sourced from fossile fuals (coil/petroleum) used facilities increasing process development and research and of using refining wastes as a fertilize in organic farming.

This study was conducted in two levels. Firstly, a prototype facility was developed for chimney gas production and waste receiving. According to this aim, an dosaging unit were added to refining process and the entered coal amount and refining liquid level were set automatically. In the meantime, it is inspected the chemical structure of refining wates were measured for balancing the working system with the releasing chimney gas emisson values, Consequentyl, the level of chimney gase level were increased and the best appropriate wastes were obtained for fertilizer production. Secondly, the received waste analyses were maden and necessary chemical and organic materials were determined for receiving different fertilizer type and the best appropriate process was selected than a demonstarion production was occured. The produced fertilizers tests were maden in laboratory conditions and the demonstation production was viewed on referenced plants.

This study was compoesed with in the greenhouse trial research as control (no ground fertilizer or chimney gas waste fertilizer application), 100, 200, 300 kg N/ha^{-1} equivalent with refining fertilizer production application, in addition to 200 kg/ha^{-1} P_2O_5 and K_2O ground fertilizer 0, 100, 200, 300 kg N was applicated asequivalant to refining fertilizer production application. This trial wa according to trial design that completely depend on chance, 4 Nitroges dosages (0, 100, 200, 300 $kg\ N/ha^{-1}$) x 2 media (200 kg/ha^{-1} P_2O_5 and K_2O ground fertilizer added and not added) x 5 different plants as corn, wheat, strawberry, hazelnut, rais and romaine lettuce) x 5 repeared and in each repeat 6 plants including an totally 1200 pot were used.

At the end of trial, depending on the applicated fertilizer amount, increases on wheat plant dry matter were occured. The optimum fertilizer dozages at plant wet weight were detected as 240 $kg\ N/ha^{-1}$ and 220 kg TG/ ha^{-1}. The optimum fertilizer dosages on plant length were detected as 210 $kg\ N/ha^{-1}$.

The optimum dry matter amount on corn plant for optimum productivity amount, the necessarywere detected as 27 kg N/ha-1 but depending on increases were occured at plant length according to increases of application doses, the optimum point couldn't be determined at TG fertilizer dosage.the optimum productivity amount dry matter amount were received as 280 $kg\ N/ha^{-1}$ and 240 $kg\ TG/ha^{-1}$ as a result of two fertilizer application on strawberry plant. The optimum fertilizer dosages on plant length were detected as 260 $kg\ N/ha^{-1}$ and 160 $kg\ TG/ha^{-1}$.

The optimum fertilizer application dosage were determined on radish plant as 240 $kg\ TG/ha^{-1}$. The optimum point couldn't be determined on Nitrogen fertilizer dosages depending on increases were occured at plant length according to increases of application doses. The optimum fertilizer application dosages were detected as 210 $kg\ N/ha^{-1}$ and 170 $kg\ TH/ha^{-1}$ on node dry matter. the optimum productivity amount on dry matter aomunt of romaine lettuce dry matter were received from the application amount as 220 $kg\ N/ha^{-1}$ and 210 $kg\ TG/ha^{-1}$. the optimum fertilizer application dosages at plant wet weight were determined as 160 $kg\ N/ha^{-1}$. and 160 $kg\ TG/ha^{-1}$.

POSSIBLE UN KYOTO PROTOCOL AFTER 30 NOVEMBER – 11 DECEMBER 2015 PARIS CONVENTION ON CLIMATE CHANGE AND WORLD CARBON DIOXIDE EMISSIONS GROWTH AND ELIMINATION TECHNOLOGY

Around eighty percent of the global energy consumption is being met by the fossil fuels such as crude oil, natural gas, low quality lignite and coal. When fossil fuels are burned, global greenhouse gases are emitted intensely to the atmosphere. Due to greenhouse effects, these gases especially carbon dioxide emissions cause global warming and climate change. Environmentally and economically sustainable energy is very important for sustainable development in the emerging economies. Developing countries rely on base load source coal-fired plants to fuel their modernisation. China is the world's biggest coal consumer, and has accounted for 80% of global demand since 2000. On the other hand, the growth rate in coal-fired generation capacity is slowing, down from 6.9% in 2010 to 2.7% in 2013. Overall, Europe and America have already cut fundamental energy source coal-fired generation capacity by over a fifth in a decade. Political pressure is growing against the most carbon-intensive fossil fuel. Coal provides approximately 40% of the world's electricity production. But of 1617 GW of global capacity, 75% is of the dirties kind, which burns at low temperatures and emits 75% more carbon dioxide than the most advanced new generation but expensive ultra supercritical plants, which burn powdered coal at high temperatures. Chimneys of most modern coal plants also emit plenty of otherpollutants. For instances, mercury emissions stunt young brains. Sulphur and nitrous oxides damage lungs. Overall coal kills around 800000 people a year, mainly in the developing countries [6]. In China it is responsible for up to a sixth of the particulates most dangerous for human health. Environmentally friendly and global green movement organisations reckon 80% of the world's coal reserves must stay in the ground if the planet is to stand a chance of keeping global warming under 2°C by 2050. However, the horizon is not wholly bleak for coalmen. Clean-coal technology can abate the worst pollution, at a cost. Schemes for capturing and storing power stations' CO_2 emissions may one day prove economic, countering reputation as a planet warming. In order to rein in carbon dioxide emissions to the atmosphere under the auspices of United Nations UN have been working hardly for nearly two decades. One of the international agreements concerning the control of the emissions is the Kyoto Protocol. The Kyoto Protocol expired at the end of 2012. To reach the new global climate changes agreement by courtesy of UN has been studied since that time. Final UN climate treaty will be most probably signed in Paris United Nations Climate Conference in November 30 - December 11. 2015.

Keywords: Climate Change, Carbon Dioxide Emissions, Coal Fired Plants, Greenhouse Gases, Renewable Energy Sources

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