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中国环境健康项目研究中心

The China Environmental Health Project

Case Study

Involving Communities in Environmental Protection Starts with Relationship Building and Education: How the China Environmental Health Project is Engaging Stakeholders for Air Quality Monitoring in Huainan, China

Challenge

China is the biggest producer and consumer of coal in the world. More than 70% of the total energy in China is produced from coal combustion. This trend is expected to continue for the next 50 or more years. The city of Huainan in Anhui Province, the so-called “Coal-Powered Three Gorges,” has a coal reserve of 44.4 billion tons, which is 32% of the reserve in eastern China and 19% of the national total. Anhui is an important Chinese energy base relying on coal, electric power, and chemical industries for its development. The total quantity of Huainan coal consumption in 2004 was 12 million tons, making up 90% of the city’s energy consumption. The production of industrial liquid, solid, and gas wastes from coal use makes up about 98% of the city’s industrial pollution emissions.

Initiative

USAID is supporting the **China Environmental Health Project (CEHP)** through cooperation (486-A-00-06-00014-00) between Western Kentucky University (WKU) and Anhui University of Science and Technology (AUST) to improve air quality monitoring and control in Huainan. This includes: (1) building up Huainan’s monitoring system for SO_x, NO_x, PM₁₀ and other air toxins resulting from coal-fired power and chemical plants; (2) training Chinese researchers in the latest environmental protection technologies; and (3) assisting AUST medical school researchers in studies of coal emissions impacts on the health of various communities. WKU is providing state-of-the-art technologies to train Chinese researchers and students about sampling and analysis of various pollutants (e.g., CO₂, SO_x, NO_x, PM₁₀, Hg, and Se), and also assist AUST in monitoring three power plants in Huainan using U.S. EPA methods to ensure quality of the sampling data. A pilot study (0.006MW) of CO₂ captured by advanced aqueous ammonia scrubbing and regeneration is setting up at the Anhui Huainan Chemical Plant.

Objectives

The China Environmental Health Project aims to obtain accurate data on coal-fired pollution emissions in Huainan, as well as generate awareness among policymakers on the health dangers of coal. A strong regulatory environment and reliable monitoring are the cornerstones of a system that can force polluters to reduce emissions. For example, better monitoring capacity can permit the adoption of some market and information disclosure type regulations such as: voluntary reporting, emissions trading, and tax-related incentives. Additionally, the CEHP research findings could help catalyze city policymakers to adopt measure to reduce public health problems caused by coal combustion. This is an alternative way to promote cooperation of both sides (China and the United States) and further application of advanced clean coal technologies available in the market worldwide.

Accomplishments

Western Kentucky University’s China Environmental Health Project (CEHP) has filled an urgent need in China to enhance scientific capacity to measure coal emissions, which are the leading cause of respiratory illnesses and a growing source of ecological harm within China and beyond.

The coal/air component of CEHP aims to obtain accurate data on coal-fired pollution emissions in Huainan City in Anhui Province. The key to success of this data collection is the strong collaborative partnership we have formed with both provincial and municipal government agencies. The collection of this information has not only helped the understanding of new pollutant sources to support new laws on environmental information dissemination, but also has generated awareness among policymakers on the health dangers of pollutant emissions.

Mercury Measurements in Coal-fired Plants: AUST sampling team is the first team in China to use the US EPA Method 30B for flue gas mercury measurement. AUST sampling team has been successful in collecting mercury in the flue gas and analyzing mercury in sorbent traps using USEPA method 30B. Quality assurance/quality control (QA/QC) procedures of method 30B were strictly observed during field testing and laboratory analysis in China. The results indicated that ESP generally captures about 30% of total mercury in flue gas. The installation of the WFGD system (which is required by Chinese EPA regulation) promotes the capture of mercury species in the flue gas. Unlike coal-fired power generation units in the United States, much fewer selective catalyst reduction (SCR) systems, which reduce NO_x emissions, are installed in China. The low chlorine contents in the Chinese coal may also cause the mercury capture efficiency at the WFGD system (between 40% and 50%) in these Chinese coal-fired power plants to be much less than that in the American’s bituminous coal (around 70% to 80%). About 32% of total mercury was emitted to the atmosphere environment in the unit with WFGD, while 69% of total mercury was emitted from the stack in the unit without WFGD. The co-benefit from the air pollution control devices (SCR, ESP and WFGD) for Chinese coal-fired power plants may have some questions to reach the higher mercury capture rate.

Pilot Study of CO₂ Sequestration by Advanced Aqueous Ammonia Scrubbing and Regeneration: Since 2002, the Institute for Combustion Science and Environmental Technology (ICSET) at Western Kentucky University (WKU) has been participating in an ongoing carbon dioxide (CO₂) sequestration research project using an aqueous ammonia scrubbing technology with China and other countries. CO₂ produced from combustion sources, such as fossil-fuel fired power plants, is captured from the flue gas. The CO₂ reacts with aqueous ammonia to form ammonium bicarbonate (ABC), which can act as a “CO₂ carrier” to “transport” CO₂ from the combustion

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of fossil fuels to soil structure and crops in the farm lands since it is water soluble.

The greatest value to be realized in developing successful strategies for CO₂ sequestration is the ability to reduce CO₂ emissions from the China's coal fired power plants. Developing a non-hazardous method to capture CO₂ from power plant stacks can potentially enable China's power sector to begin to save and trade "carbon credits" while in the same process produce a stable nitrogen-rich and soil quality enhancing fertilizer—a win-win outcome.

For the past year, the AUST-WKU team has focused on the experiments in a conceptive reactor and also a scaled-down onsite slipstream reactor. A pilot-scale reactor system (0.006MW) has been built and a series of experiments have been conducted in this phase in order to come up with a detailed phase diagram for the CO₂-NH₃-H₂O reactions and optimum condition to produce ABC. Additives will be used to produce LEABC during this process to evaluate its function to shift phase diagram and product distribution. The influences of solution inventory, solution recirculation rate, temperature, rotating speed, residence time, as well as flue gas components (SO₂, NO_x, Hg) on CO₂ removal efficiency and solid products will be investigated. The fates of major pollutants in the flue gas atmosphere, such as SO₂, NO_x and Hg will be investigated. The three-phase diagram will be developed in this phase. The modified phase diagram will be the basis for application and conversion of the proposed system to a commercial scale.

The absorption tower (total height of 60ft and weighing 9 metric tons, 75kg/hr of production rate) has been built and moved to the Anhui Huainan Chemical Plant. The crystallization storage tower and the solution tower have also been built and moved to the site. The connection (pipes, meters, and valves) among towers has been initiated and will be completed by mid- June 2010. Experimentation will start at the beginning of June. The total cost to build this unit is more than 1.5 million RMB (US\$224,000) and includes financial support from Huainan Chemical Plant, Huainan City Government, Ministry of Science and Technology (MOST) in Beijing and USAID. A public ceremony has been planned for the summer of 2010.

Accomplishments

(1) Over the past three years, this project provided four training seminars. The workshop/seminar provided an excellent platform for scientific information exchange between government officials, professors, scholars, students from China and USA. AUST students have also been involved in several activities every year such as (a) "4.22 international earth day", (b) "6.25 world environment day", and (c) "students summer work program in farm", to introduce the program information to the public. The publicity from these workshops/seminars have also been reported and broadcasted through different media sources such as Huainan Daily News, Huainan TV stations, and web sites.

(2) For past three years (2006-2009), approximately 20 junior faculty, 199 graduate students, and 4,800 undergraduate students took part in training at various levels of this CEHP project including training, workshop classes and on-site sampling. The goal of which was to determine how much pollutant is produced in the solid and gas phases of coal burning.

(3) 21 new classes were also added into the curriculum related to the environment health project at AUST.

(4) The establishment of new post-doctoral institute for the "Environmental Science and Engineering" at AUST was awarded by the Chinese central government in 2009. The CEHP project has had a great impact on the selection of this award.

(5) There are a total of 11 publications and 6 presentations as a result of this project,

(6) This project has been reported more than 46 times in different media such as Anhui TV station, Huainan TV station, Huainan Daily News, different radio stations, and AUST News web site.