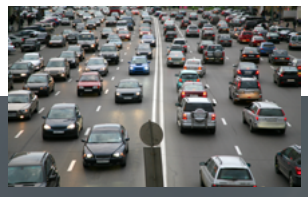
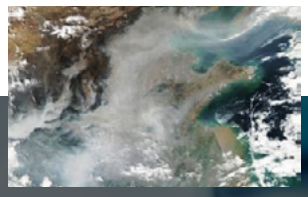
Another notable approach that this project made was to extend the impact assessment of air pollution to historic monuments. The purpose of this trial was to examine how the APM affects the historic objects and prevent their degradation. Meetings and training courses were held in Myanmar and Sri Lanka to disseminate nuclear analytical techniques, such as X-ray fluorescence analysis, for monitoring the impacts of APM on cultural heritage structures.

Key outcomes of this long-term regional collaboration have become invaluable assets to decision making end-users and environmental protection agencies for investigating the current environmental situations and reinforcing air pollution control strategies in the Asia-Pacific region. This project brought highly sought after knowledge, expertise and technology to the region to fight air particulate matter pollution for the benefit of the public. The Government Parties' continuous endeavor and technical cooperation are expected to take on a bigger role in preventing the deterioration of human health and climate change, thereby improving the quality of life.

GENT Stacked Filter Unit

The GENT Stacked Filter Unit was developed as a means to collect particulates in separate fine (PM2.5) and coarse (PM2.5-10) size fractions. The air enters the unit through an impactor stage and then is drawn through a stacked-filter unit by means of a vacuum pump in which the fine and coarse particulates get stacked on two sequential Nuclepore filters. A 24-hour operation of this unit corresponds to a total volume sampled of 23 cubic metre.

The IAEA provided the participating RCA Government Parties in the above mentioned projects with this GENT Stacked Filter Unit in order to obtain comparable samples taken in various locations in the Asia Pacific region. The Government Parties analysed the collected airborne particles either by themselves or in cooperation, and the collated results were used to investigate air pollution matter in the region as a whole.

Regional Cooperative Agreement
For Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific
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RCA Success Story 2020 Edition

Collaborative and Sustained Efforts to Improve the Air Quality in the Asia Pacific Region

RCA Regional Office
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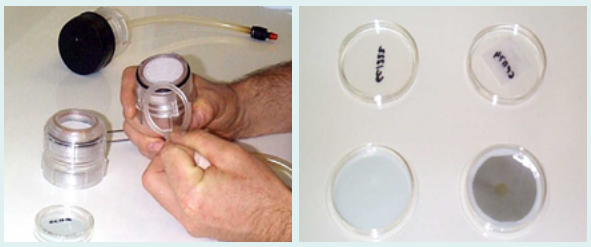
Collaborative and Sustained Efforts to Improve the Air Quality in the Asia Pacific Region

Air pollution has now become the most lethal environmental health threat globally. According to the recent estimates by the World Health Organisation (WHO), about 7 million deaths result from cancer, heart disease and pulmonary illnesses caused by the combined effects of outdoor and household air pollution around the world every year. In addition, the environment and ecosystem have been severely affected by the hazardous condition, as evidenced from climate change and the associated impacts. This threat is magnified in the Asia Pacific region where rapid population growth and industrialization have elevated the level of air particulate matter (APM). APM is a mixture of solid particles and liquid droplets formed in the atmosphere as a result of complex reactions of pollutants emitted from natural and anthropogenic (man-made) sources such as power plants, industries, motor vehicles and so on. As the precursor of smog or haze, APM creates damaging impacts on public health, causing devastating respiratory problems and cardiovascular damages, when inhaled. It is also transported by the wind to other locations and contributes to climate change, resulting in severe environmental consequences and degradation of living conditions.

GENT Stacked Filter Unit

In order to combat this problem, the RCA has implemented consecutive projects over a prolonged period to monitor and analyse the microscopic airborne particles using **Nuclear Analytical Techniques (NATs)**. Unlike conventional techniques, the NATs provide information on elemental composition of air particulate matter with high sensitivity and speed. Through these projects, the participating Government Parties were provided with equipment such as the GENT Stacked Filter Unit, and related technical skills to sample the airborne particles. Regular air sampling campaigns were organized within the project participants in a harmonized way made available to get the air quality data, source identification and transport properties at a regional level. The samples were analysed autonomously or with technical support from regional resource units represented by Australian Nuclear Science and Technology Organisation (ANSTO) in Australia and the Institute of Geological and Nuclear Sciences (GNS Science) in New Zealand. Based on the measurements of fine and coarse particulate matter compiled through the above activities, two world-class aerosol databases were established – the **Asia Pacific Aerosol Database (APAD)** and the **Asia Pacific Source Fingerprint Database (ASFID)**. The APAD contains the data of elemental concentrations for 35,000 APM samples collected from the Government Parties throughout the span of over 15 years, whereas the ASFID contains receptor source fingerprints and source apportionment solutions obtained from the APAD dataset, using positive matrix factorization algorithm. The analysis of these databases have worked as an effective means to identify the origin of both local and regional air pollutants, making it possible to track long range transport of the pollutants over hundreds of kilometers. For example, the movements of particulate pollution, including secondary sulfur from coal fired power stations in China into Vietnam, smoke from forest fires in Indonesia into Malaysia, dust from the Gobi desert in China to Korea, smog haze from India into Pakistan and sulfur emissions from Indonesian volcanoes across the Indonesian archipelago, could be identified using this methodology. Freely available on the ANSTO and the IAEA websites, these datasets are being used by aerosol and health researchers as valuable resources to analyse and understand the atmospheric conditions.

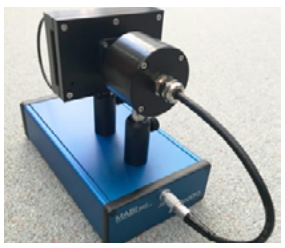


Filter cassette in stacked filter head (left) and blank and exposed Nuclepore filters (right)

Furthermore, the results obtained from these projects also provided an essential basis to pollution regulators, such as the environmental protection agencies, for developing policies and standards in relation to air pollution. For instance, the government of Bangladesh proclaimed an order banning two-stroke engines which contributed to the major portion of vehicle emissions of fine particles in Dhaka, while several other countries banned leaded petrol use across urban areas to reduce the lead inhalation by residents. By 2019, 13 out of 15 participating countries had established air pollution programs to address their respective air particulate problems.

In 2016, another succeeding RCA project, RAS/7/029 "Assessing the Impact of Urban Air Particulate Matter on Air Quality," was launched to address the worsening fine particulate matter pollution in urban areas of the Asia Pacific countries. The project was regarded timely and necessary as the atmospheric contamination in those areas became so conspicuous that it caused visibility impairment, raising public concern about its impact on deterioration of life quality. Around 7,000 new samples were collected, complementing the above mentioned databases with information on airborne particles in highly polluted zones. This has contributed to identifying the impact of local and regional industries, manufacturing and motor vehicles on urban air sheds and their trans-boundary movement in a more comprehensive way.

In order to add accuracy to this investigation, the Australian team developed the Multi-wavelength Absorption Black Carbon Instrument (MABI) technology, designed to measure black carbon concentration and differentiate the sources including biomass burning and diesel vehicles during the project. This invention was recognized to be very effective for determining the severity of urban air pollution as black carbon is a key component of the fine particles that is detrimental to the environment and human health. MABI was used not only to examine the air quality within Australia but also to provide the analysing services to the other participating countries as a cooperative activity throughout the project.



MABI (Credit: ANSTO)