# SOUTH PACIFIC REGIONAL PROJECT PASSIVE AIR SAMPLING PROTOCOL 2009

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## 1.0 Introduction

The introduction of xenobiotic chemicals that are generally referred to as persistent toxic substances (PTS) into the environment and the resulting effects are major issues that give rise to concerns at local, national, regional and global scales (UNEP/GEF, 2002). During the past 70 years or so, more and more organic chemicals have been introduced into the environment through various human activities (Kozoil et al, 2001). Persistent organic pollutants (POPs) are stable in the environment, undergo long-range atmospheric transport (LRT), and can bioaccumulate through food-chains (Jaward et al, 2004).
The Stockholm Convention on POPs was adopted in May 2001 with the objective of protecting human health and the environment from POPs and came into effect in May, 2004. Parties to the Convention are required to develop National Implementation Plans to demonstrate how the obligations to the Convention will be implemented and therefore they will need the establishment of arrangements to provide themselves with comparable monitoring data on the presence of the chemicals listed in the Annexes and their global regional environmental transport (Klanova et al, 2004).
Passive air samplers (PAS) of this design were first introduced in the Czech Republic in 2002 during the European screening campaign performed by Lancaster University and focused on the atmospheric levels of POPs. Three years (2003-2005) of intensive research in the field of passive air sampling techniques and many field studies performed at Research Centre of Excellence for Environmental Chemistry and Ecotoxicology (RECETOX) proved the applicability of this tool in the long term air quality monitoring including an assessment of the spatial and temporal trends.Since the high volume air samplers are expensive devices requiring reliable power supply as well as trained operators are not widely available, the air monitoring of POPs has been conducted at limited number of sites. In the last few years, however, new demands resulted in the development of a range of PAS as new tools for the air quality monitoring (Klanova et al, 2007). PAS offer a cheap and versatile alternative to the to conventional high volume air sampling and they have been currently recommended as one of the methods suitable for the purpose of new long term monitoring projects (Klanova et al, 2007).
This passive air sampling protocol was designed through collaborations with the RECETOX and by using materials from the TOCOEN Report No.300. The air sampling protocol will be utilized in six countries of the Pacific (Samoa, Niue, Tuvalu, Solomon Islands, Kiribati and Fiji) for training purposes for regional personnel as well as PAS deployment in the regional countries.

## 2.0 Principle of method

Passive air samplers operate without the aid of a pump and consist of an accumulating/absorbing medium that has a high retention capacity for the target analytes (Pozo et al, 2004).

Low sensitivity to accidental short-time changes in the concentration of pollutants is a basic characteristic of passive air samplers. They provide information about the long-term contamination of the studied environmental compartment (for example air).

The air streams freely around a filter, membrane or other medium (sorbent), which captures pollutants during the period of passive air sampling. It is possible to use polyurethane foam (PUF) for persistent organic pollutant (POPs) sampling.

The relationship between the amount of POPs captured on PUF filter and their concentrations in sampled air has not been mathematically fully described yet. Due to this reason only empirical estimated information (based on parallel active and passive measurements) is available for results interpretation. Passive air sampling is a cheap screening method for a comparison of contamination on various sites or for verification of information obtained by active samplers.

## 3.0 **Materials and PAS Preparation**

Passive air sampler consists of (i) two stainless steel bowls with diameter 30cm and 24 cm; (ii) a stainless steel rod which will hold all the parts in a common axis; (iii) nuts and pads; (iv) two distance tube – to hold the different bowls onto the centre; (v) hanging hook – to hang the sampler at any site; (vi) safety hooks – to protect the sampler against falling apart due to vibrations caused by strong winds, simultaneously enables the sampler to stabilize in a vertical position.

**3a. Stainless steel bowls with diameters of 30 cm and 24 cm.**

**3b. The stainless steel rod is initially attached to the larger bowl with nuts and pads. The upper bowl is placed upside down to protect the filter from rain and solar radiation and also stabilizes a stream of air around the filter.**

**3c. A nut is fastened to the upper bowl with a distance tube (longer one) inserted plus a nut fastened to hold the tube.**

**3d. Place the PUF filter (with metal insert) onto the rod plus a pad and nut**
**PUF filter with metal insert which holds the PUF onto the metal holder**

**3e. Insert the shorter distance tube plus a pad.**

**3f. Insert the smaller bowl and attach a pad plus two nuts to fix the lower bowl.**

**3g. Two nuts fixed onto the lower bowl**

**3h. The PAS sampler is ready for deployment onto monitoring site.**

Removal of dirt and surface cleaning would need alcohol, especially inside the bowl, during filter change. Water and hexane are sufficient for cleaning for better removal of smear from the surface of the sampler.

**4.0 Polyurethane Filters (PUF)**

Filters are made of white, non-coloured polyurethane foam disks with a density of 0.030g/cm$^3$ (type N3030; producer Gumotex Breclav, Czech Republic) are used as a sorbent for passive sampling of POPs. Filters are circular is shape with a thickness of 150mm (Kohoutek, 2006). All filters are cleaned before placement into the passive air sampler ( 8 hours extraction in acetone, and 8 hours extraction in dichloromethane). Filters are dried after extraction and the

cleaned stainless steel insert (length 15mm) is palced in the middle to fix the filters to the axia of the sampler (Kohoutek, 2006).
The filter with insert is packed in two layers of aluminum foil after cleaning.Date of cleaning and signature of worker are written with a permanent marker on the packed filter. The labeled filter is placed into a zip-locked plastic bag. Clean filters are then placed in a freezer at a temperature of
-18 $^{o}$C for up to three months.

**5.0 Sampling**

Passive air samplers are hung vertically with the bigger bowl facing upwards. They are paced 1.5-2.0m above ground during sampling. The duration of the sampling is usually four weeks (28days) or for a total of three months. The interpretation of results has to be done with respect to this duration factor.
6.0 Filter Exchange

Prior to installing a new filter the current filter has to be removed. Steps in removing a filter for analysis is a follows:

(a) Detach the sampler from the hinge;

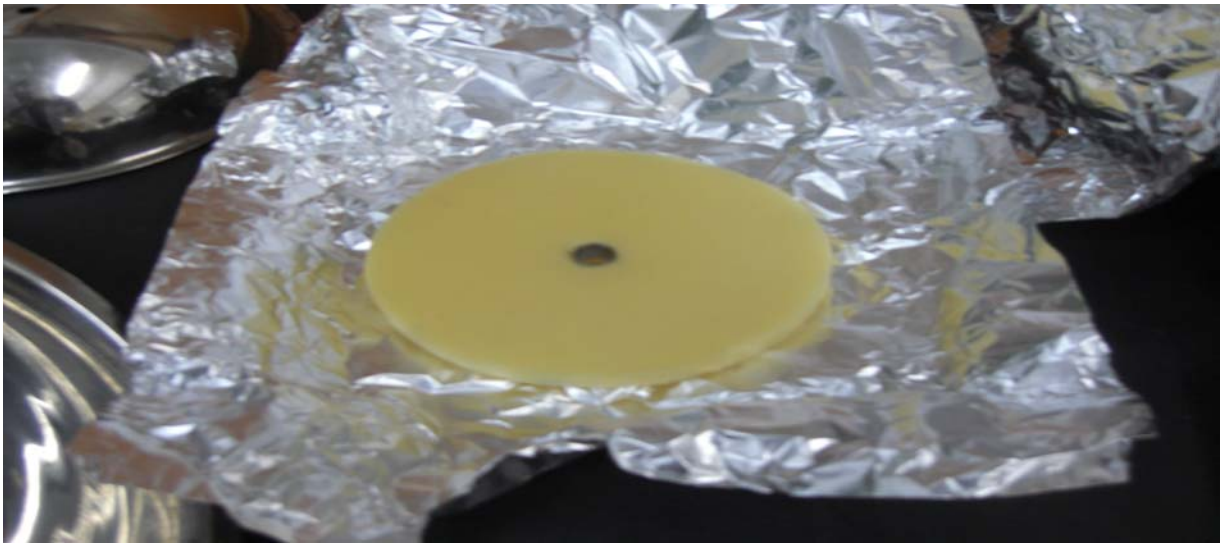
(b) Remove the safety hook, nut, safety nut and pad starting from the top;

(c) Carefully remove the lower bowl without contacting the filter;

(d) Remove the pad and nut fixing the distance tubes;

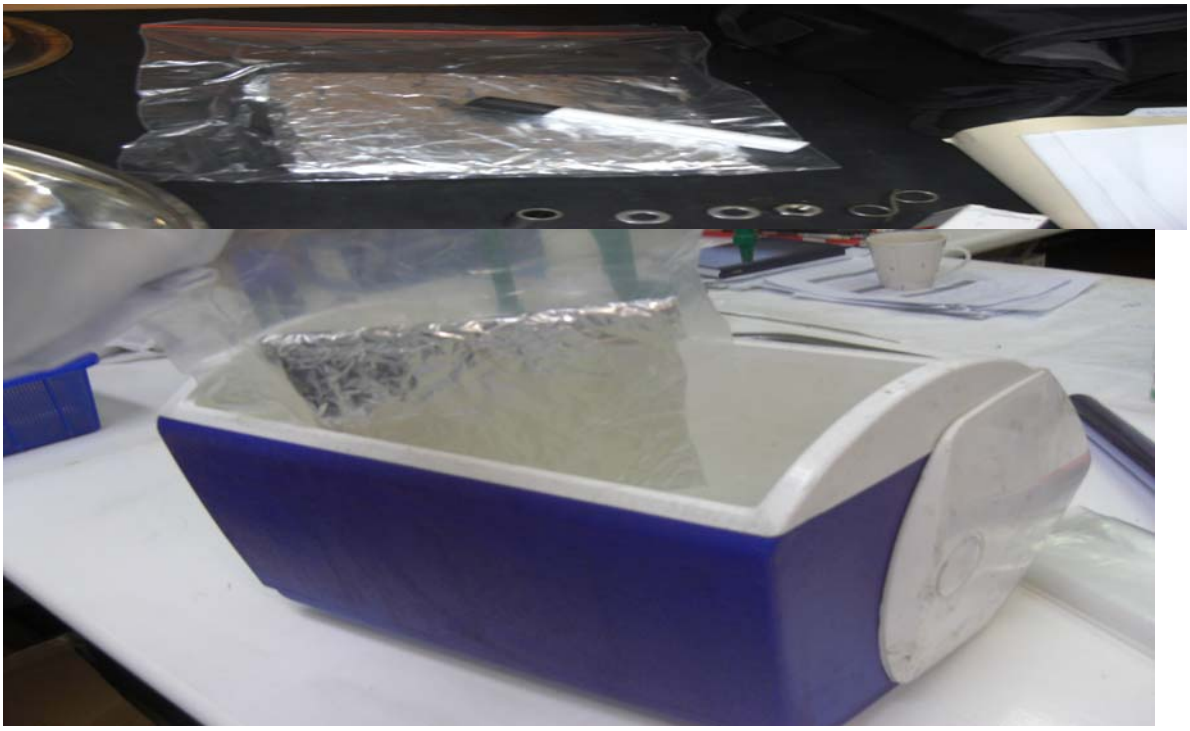
(e) Carefully remove the shorter distance tube and the pad next to the filter ( without contact with the filter);

(f) Using gloves or aluminum foil remove the filter including the stainless steel inserts placed in the centre and wrap it into two layers of aluminum foil;



(g) Label the wrapped filter (date, site, number of sample) using a permanent marker;

(h) Place the labeled filter into a polythene zip-locked bag and put it into the ice box for transport back to the lab;



(i) Carefully write all the data about the filter (date of beginning and end of sampling dates, meteorological conditions during sampling) to the sampling protocol;

(j) Remove possible dirt on the bowls before installing a new filter;

(k) Write the date and beginning of sampling details on the sampling protocols, name of sampler, description of site and GPS position of the site into the sampling protocol;

(l) Set up the new filter like the earlier steps discussed.

## 7.0 Analytical Analysis

The analysis of the filters proceeds according to the appropriate SOP of the analytical lab concerned.

## 8.0 Results Interpretation

Passive air samplers using PUFs are suitable for monitoring of same type of POPs such as the more volatile compounds from the polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organochlorinated pesticides (OCPs) (Kohoutek, 2006). Less volatile compounds (high molecular PAHs) are also collected on the filter, but only partially (sorbed onto dust particles (Kohoutek, 2006).
Sampling rates between 3-5 $m^3$/day were determined by empirical measurements. This is approximately 100-200 $m^3$ for a 28 days sampling cycle.

**References**

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