ISOKINETIC AIR SAMPLER

CONTRACTUAL ORIGIN OF THE INVENTION

The invention described herein was made in the course of, or under, a contract with the UNITED STATES DEPARTMENT OF ENERGY.

BACKGROUND OF THE INVENTION

This invention relates to an isokinetic air sampler. The invention also relates to a system for taking air samples isokinetically so that the airborne concentration of particulate pollutants can be accurately measured. The invention further relates to a method of sampling air isokinetically to measure airborne concentration of particulate pollutants as a function of wind speed.

Air sampling systems capable of monitoring the atmosphere to determine the extent of pollution by particle emission and to determine how effective antipollution control devices are are well known. Such devices normally use a filter to collect the particles employing an air pump to draw air through the filter. If the air pump is turned on at all times, it is not possible to obtain samples representative of conditions at any particular wind speed; if the air pump is turned on only when the wind speed is at the desired value, air impact pressure will force some air through the filter and cause some particle collection when the air pump is turned off. In addition sampling will not necessarily be isokinetic; i.e., introduced into the sampling system without substantial perturbations of the kinetics of the gas being sampled. If the flow of air around the sampler is at a different speed from the flow of air into the sampler, the sample may not accurately reflect the air being sampled because of the inertia of the particles approaching the sampler.

Monitors have long been known which collect or sample particulate matter from stack gas or any gas flowing through a conduit and isokinetic samplers and techniques for this purpose are well known. The wide variations observed with respect to wind speed, however, do not normally apply to a stack or conduit. Thus samplers and sampling techniques used for air sampling have not heretofore been accurate enough to measure airborne concentrations of particulate pollution as a function of wind speed.

SUMMARY OF THE INVENTION

An isokinetic air sampler includes a filter, a holder for the filter, an air pump for drawing air through the filter at a fixed, predetermined rate, an inlet assembly for the sampler having an inlet opening therein of a size such that isokinetic air sampling is obtained at a particular wind speed, a closure for the inlet opening and means for simultaneously opening the closure and turning on the air pump when the wind speed is such that isokinetic air sampling is obtained. A system incorporating a plurality of such samplers provided with air pumps set to draw air through the filter at the same fixed, predetermined rate and having different inlet opening sizes for use at different wind speeds is included within the ambit of the present invention as is a method of sampling air to measure airborne concentrations of particulate pollutants as a function of wind speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cut-away perspective view of an air sampler constructed in accordance with the present invention, and

FIG. 2 is a sketch showing an air sampler together with associated equipment.

As shown in FIG. 1 an isokinetic air sampler **10** according to the present invention includes a conventional filter **11** carried within a conventional filter holder **12** which includes funnel-shaped outlet **13** terminating in an end fitting **14** to which is attached a high volume air pump **15** (See FIG. 2) for drawing air through the filter. Attached to filter holder **12** is an inlet assembly **16** including a slanting roof **17** which angles up from a flat roof **18** to fit over holder **12**. Flat roof **18** is parallel to a bottom member **19**, and joined to the bottom member **19** by side walls **21** which together define an inlet opening **20** of predetermined cross sectional area.

Inlet opening **20** is provided with a pivotally mounted closure member **22** of greater depth than the inlet opening operated by solenoid **23** through link **24**. Both slanting roof **17** and flat roof **18** are provided with rain runoff deflectors **25**. In addition an imperforate impact deflector **26** extends upwardly from bottom member **19** to the bottom of the filter—a distance a little greater than the height of inlet opening **20**.

A plurality of such air samples are employed to provide a system for taking air samples isokinetically at different wind speeds. Each sampler will have a differently sized inlet opening such that for each sampler isokinetic air sampling will be obtained at a different wind speed. Wind speed sensors **27** (See FIG. 2) sense both wind speed and wind direction and open closure member **22** and turn on air pump **15** when the component of wind speed from the direction into which the samplers are facing is at a predetermined value. So that wind gusts will not affect operation, a 15–20 second delay time is built into the system. Thus a set of samplers will cover a complete range of wind speeds within which sampling is to be undertaken and within a set one and only one of the samplers will be operating whenever the wind speed is within the range covered by the set.

The invention will be described in detail as installed at Hanford Works, a Department of Energy installation at Richland, Washington. For a particular investigation a large number of these samplers were mounted at various elevations at various locations all facing in the same direction. The same commercially available filter—a Gelman type A glass fiber filter 20 cm high by 25 cm wide—was employed in each sampler and air was drawn through each filter by an air pump operating at 1.13 cu. meters/min. Also all samplers have a 25 cm. wide inlet opening, the height of the opening being dependent on the wind speed of the air to be sampled. Inlet assembly is formed of 16-gauge aluminum, the flat roof portion of the sampler being 7.5 cm. long and the total distance between inlet opening and filter being 25 cm. The height of the inlet opening is determined as follows:

Flow (cu. meters/min) = windspeed (meters/minute x area of slot) (sq. meters).

Thus the height of the inlet opening to be used at various wind speeds is as follows.

1.5	meters/sec	5.0 cm
4	meters/sec	1.88 cm
6	meters/sec	1.26 cm
9	meters/sec	0.84 cm
13	meters/sec	0.58 cm