

#### **4-1 DUST PARAMETERS**

**There are four types of dust which is:**

- 1- **Dust sand storms:** - These storms are accompanied with strong winds (about 18 knots or more) (1 kn = 1.852 km/h). And the horizontal visibility is less than 1000 meters and when the visibility is deteriorated **يندهور** below 200 meters, the storms is regarded as severe dust - storms or severe sands storm.
- 2- **Rising dust:** - Winds are generally moderate and the horizontal visibility is equal or more than 1000 meter.
- 3- **Suspended dust:** The horizontal visibility is less than 1000 meters with thick suspended dust, but when its moderate, the visibility ranges between 1 km and 5 km, where the dust is not raised by local winds and where winds are generally light or calm.
- 4- **Haze:** Very small solid particles of dust, smoke or salt. Horizontal visibility is equal to or more than Kms.

#### **4-2 MEASURING SYSTEM OF DUST**

In this part, it is very important to describe the new and highly sensitive aerosols measuring systems. These systems have been installed at the solar physics laboratory which located at the Solar Energy Research Centre in Baghdad.

**The dust lab consists of following items:**

- 1- Dust photometer for continuous dust monitoring on chart recorder and under computer control.
- 2- Battelle particle counter with fibre recognition working separately or under computer control via microprocessor control unit.
- 3- Portable dust photometer scheduled for field applications, but also connectable to the computer, if necessary.
- 4- Microprocessor control unit for interfacing units 1 and 2 (possibly also units 3 and 6) with Phillips Computer.
- 5- Phillips's computer P 2000 C.
- 6- Two portable dust samplers for field applications
- 7- Stationary dust sampler with programmable filter exchange.
- 8- Clean air box for filter handling
- 9- Oven for filter drying.

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- 10- Sensitive scales for filter measurements.
- 11- Light microscope for dust observations.
- 12- Tool for studying of light absorption and diffraction on contaminated glasses or mirrors.

The microprocessor control unit is connected with the Phillips Computer via IEEE interface. This allows to have a full access to all addresses from the computer.

The delivered software which is written in BASIC allows to run the dust lab in a quite universal way.

The software is comprised of three program disks for operating the system which are:

1. Operating - system software which belongs to the computer and which includes software for copying, word processor, etc.
2. Measuring software
3. Analysis software for stored data.

**The dust photometer** is used to ensure an automatic and continuous monitoring of dust density measured in  $\text{mg}/\text{m}^3$ . It is extremely sensitive and allows measurements over some orders of magnitudes.

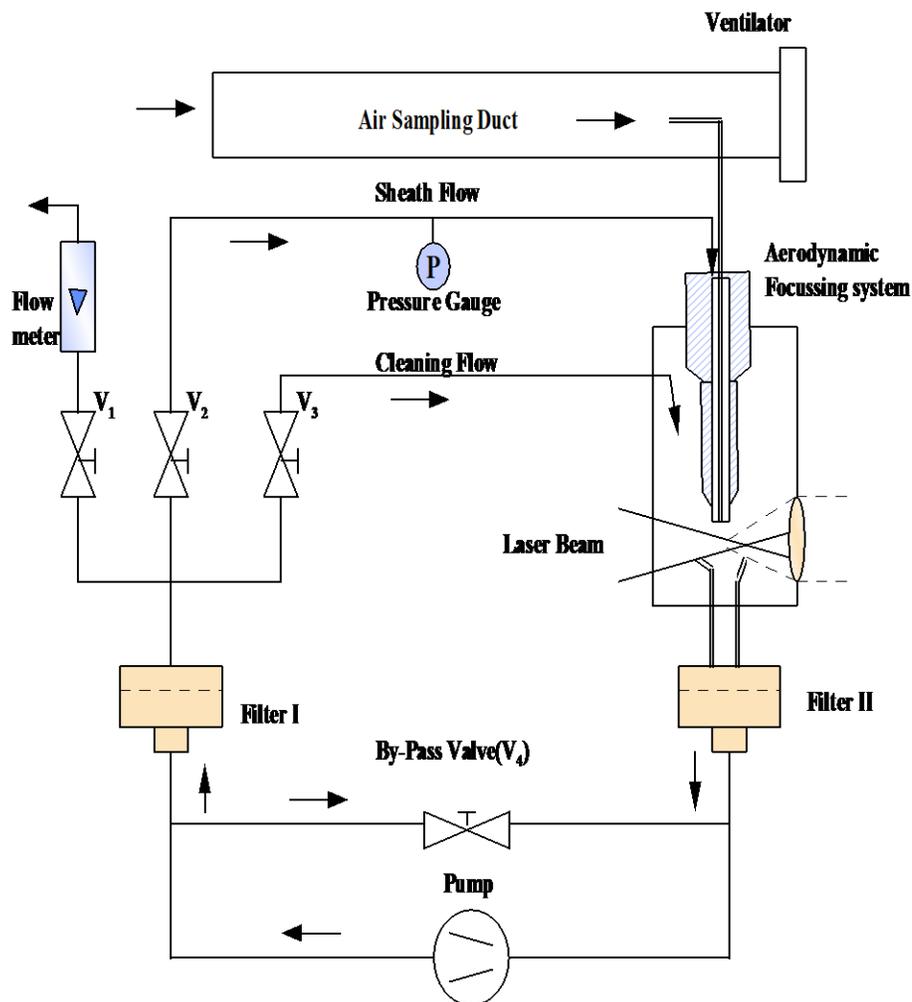
The light detectors are composed of a tungsten lamp which is positioned at 15-degree angle of the incoming light beam with a spectral range of (360 to 2800 nm), the detection is achieved by means of a secondary electron photo-multiplier type 931A and it is based on the principle of 15-degree scattered light (Fig. 1).

When the light beam hits the dust particles, a signal is obtained at the detector which is proportional to the dust concentration measured in mg per cubic centimetre  $\text{mg}/\text{m}^3$ .

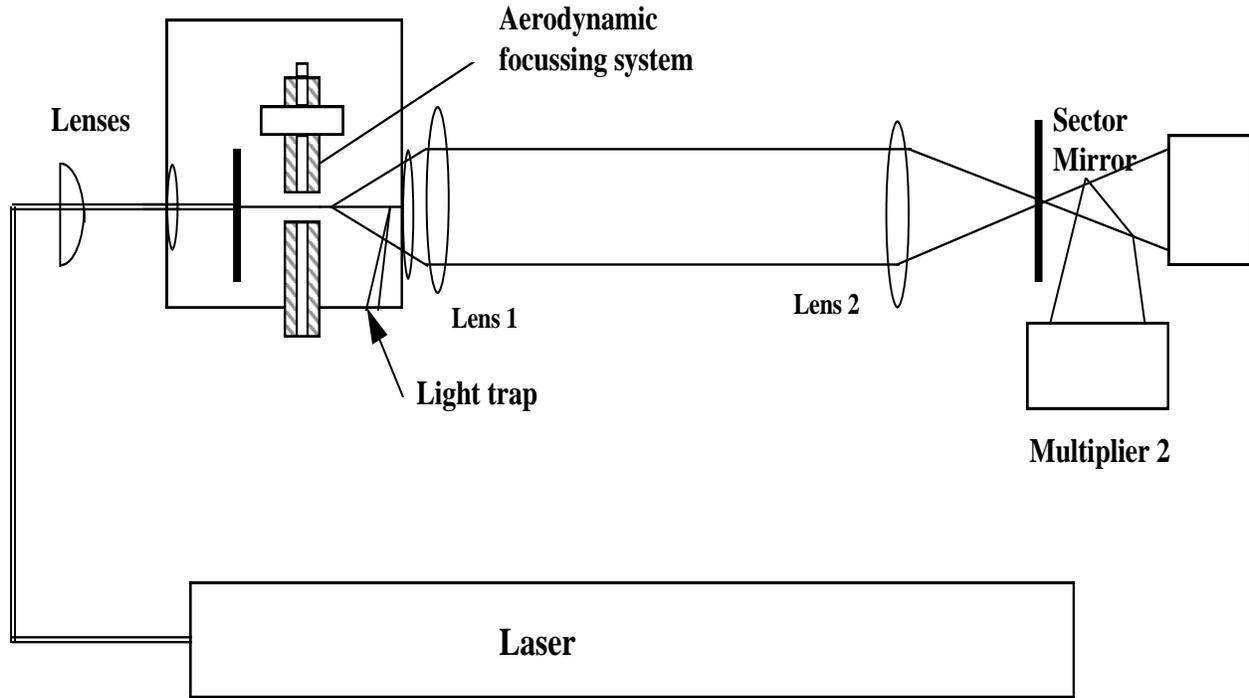
**Battelle laser - optical photometer** measures the shape and size distribution of dust particles. The photometer is an advanced instrument designed for on the spot measurements of the airborne concentration of fibre shaped and normal dust particles.

The light source of the photometer is He-Ne laser having beam diameter of 5 mm and optical power of 0.8 mw with wavelength 632.8 nm. For the normal dust particles, a classification by size can be carried out on the basis of a computerised pulse-height analysis.

The dust loaded air sample is sucked into an aerodynamic focusing system, in which it is surrounded by a sheath flow of clean air and then concentrated to a narrow core of about  $100\ \mu\text{m}$  diameter by means of a nozzle. By the action of this nozzle the dust particles are accelerated and arranged in line so that they can be carried across the laser beam one at a time *واحدًا تلو الآخر*. The sensing volume is determined by the width of the aerosol stream (approximately  $100\ \mu\text{m}$ ) and the height of the laser beam (about  $40\ \mu\text{m}$ ). Behind the sensing volume the illuminating laser beam is blocked by a light trap whereas the light scattered by the particles is collected by a lens and relayed towards a four-quadrant photo detector system by means of an additional lens (Fig. 2).



**Fig. 1 - Aerosol sampling system**



**Fig. 2 - Schematic of the laser optical photometer**

The intersection of the detector into four electrically independent quadrants makes it possible to determine whether the scatter pattern produced by an individual particle shown an isometric distribution around the optical axis, thus indicating a normal particle, or whether a more or less asymmetric distribution is observed, which is typical for a fibre.

إذا كان نمط الانتثار الناتج عن جسيم فردي يظهر توزيعًا متساوي القياس حول المحور البصري، مما يشير إلى وجود جسيم عادي، أو توزيع غير متماثل إلى حد ما، وهو نموذجي للألياف

For the non-fibrous aerosol particles, their size is determined by means of height analysis of the recorded scatter pulses. In other words, if the particle has a spherical shape, the signal in both channels will have approximately the same height because the diffraction pattern is elliptically - shaped, and therefore both signals will have different amplitude. This effect is used to separate fibres from spherical particles. In addition, the pulse height itself will vary with the particle size and this allows the measurement of the size distribution of dust.

إذا كان للجسيم شكل كروي، فإن الإشارة في كلتا القنوات سيكون لها نفس الارتفاع تقريبًا لأن نمط الانعراج بيضاوي الشكل، وبالتالي سيكون لكلتا الإشارتين اتساع مختلف. يستخدم هذا التأثير لفصل الألياف عن الجزيئات الكروية

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The output data from the Battelle photometer are detected through 10 main channels which are related to particle size ranges in 256 single channels in the microprocessor control unit (zero to 255 corresponding to addresses 100 to 355).

The system has proved to be very sensitive and highly accurate in measuring the dust density and size distribution of aerosol particles, and fibres. The data obtained are of very high quality and easily accessible.