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(54) Exhaust air particulate contamination sensing for tumbler dryers
Erfassung von Verunreinigungsteilchen der Abluft eines Trommelwäschetrockners
Détection des particules de contamination de l’air de sortie d’un sèche linge à tambour

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a dryer comprising a particulate monitoring system. The invention is especially applicable for clothes dryers dedicated to drying garments to be worn in clean room environments.

BACKGROUND OF THE INVENTION

[0002] The manufacture of delicate and intricate microelectronic circuits and components typically requires a clean room environment. Persons working in such environments must wear protective body suits that prevent pollutants or contaminates from the person or person’s clothing from becoming airborne. Once airborne, such pollutants can adversely affect such circuits or processes for their manufacture.

[0003] Although disposable clean room body suits are known, reusable, washable suits are generally preferred. The laundering of clean room garments presents particular challenges since upon laundering and drying, such garments must be relatively free of pollutants or contaminants. Typical pollutants include dust, lint, or other microparticles, which can readily become airborne in a clean room environment.

[0004] When laundering clean room garments, the current practice is to launder multiple batches of garments and measure the level of particulates of a small number of representative samples. Samples are generally taken of air which contacts the garments after laundering, such as during or subsequent to drying of the garments. Samples obtained during drying typically necessitate interrupting the drying cycle to withdraw samples for subsequent analysis. If a representative number of laundered samples meet the requisite cleanliness level, the collection of laundry batches is deemed acceptable. This practice requires a technician to determine how many samples need to be taken, withdraw the samples, analyze the particular samples, decide whether the garments are at a satisfactory level of cleanliness, and if not, continue the laundering or drying operation until such level is reached.

[0005] Although satisfactory in most respects, this practice is undesirable in view of the time and labor associated with the activities of the technician, the inevitable occurrence of some garments leaving the laundering facility, having levels of particulates that exceed the maximum limit due to reliance upon only a sampling of laundered garments, and the additional costs resulting from overlaundering or cleaning some garments beyond the required cleanliness level since only a sampling of laundry batches are utilized to indicate the cleanliness level of an entire collection of laundry batches. Document JP 07 080194 A discloses a dryer which shows all the features of the preamble of claim 1. Thus, it is desirable to provide a method and/or device that overcomes these disadvantages. Furthermore, it is desirable to provide an indication of the particulate level of every laundered batch, and thus, confirmation that each batch is at the requisite cleanliness level.

[0006] The present invention achieves all of the foregoing objectives by providing an apparatus and a method according to claims 1 and 13. The dependent claims contain further advantageous features of the apparatus and the method of claims 1 and 13.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of a preferred embodiment dryer system comprising a particulate measuring system in accordance with the present invention;

FIG. 2 is a perspective view of an exhaust duct from the preferred embodiment dryer system depicted in FIG. 1, illustrating a sampling line for the particulate measuring system in accordance with the present invention;

FIG. 3 is a schematic diagram illustrating the preferred embodiment dryer system;

FIG. 4 is a block flow diagram illustrating the operation of the preferred embodiment dryer system; and

FIG. 5 is a schematic diagram illustrating a preferred alternate embodiment dryer system comprising a remotely located particle counter device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] The present invention provides a dryer system comprising a particulate measuring device that monitors and/or governs dryer operation and enables the removal of particulate contaminants from garments to a predetermined level. Moreover, the dryer system of the present invention documents the initial and final levels of particulates in, associated with, or carried by garments and thus provides an accurate record that every laundered batch is at the requisite level of cleanliness. It will be understood that the terms “particle” and “particulate” are utilized interchangeably herein.

[0009] FIG. 1 illustrates a preferred embodiment dryer system 10 according to the present invention. The dryer system 10 comprises a dryer 30, most preferably a tumbler dryer, having one or more cabinets 31, one or more doors 32 providing access to an interior chamber, preferably a rotatable drying drum 33 for receiving and tumbling garments disposed therein, and a dryer exhaust duct 34 for directing dryer air from the drying drum 33. The dryer system 10 further comprises a dryer control unit 20 generally providing for setting dryer time periods and drying parameters. It is preferred that the
control unit 20 comprises a storage or memory unit whereby one or more control parameters can be input and stored within the control unit 20. The dryer system 10 further comprises a particle counter device 40 and a measuring sample pump 50 described in greater detail below.

[0010] FIG. 2 is a perspective view of the dryer exhaust duct 34 typically located along the dryer underbody and below the drying drum 33. The dryer exhaust duct 34 comprises one or more walls or panels 35 configured to define an exhaust air inlet 36 and an exhaust air outlet 37. Although the dryer exhaust duct 34 illustrated in FIG. 2 is depicted as providing an upward facing exhaust air inlet 36 and laterally directed exhaust air outlet 37, other configurations are contemplated and encompassed within the present invention. When incorporated into the dryer 30, heated air exiting the drying drum 33 enters the dryer exhaust duct 34 through the exhaust air inlet 36 as shown in FIG. 2 by airflow lines A. The dryer exhaust duct 34 directs the heated exhaust air through the exhaust air outlet 37 as shown in FIG. 2 by airflow lines B. Disposed along a wall 35, preferably at a midpoint along the length of a wall opposite the exhaust air outlet 37, is a sampling line 42 for transferring a sample of the dryer exhaust air, e.g. airflow lines A, from the dryer exhaust duct 34 to the particle counter 40. The open end of the sampling line 42 is referred to herein as a sampling port. It is most preferred that the end of the sampling line 42 or sampling port is directed toward the dryer exhaust air entering the dryer exhaust duct 34 as illustrated in FIG. 2. Other locations and configurations for the end of the sampling line 42 besides that shown in FIG. 2 are contemplated. For instance, the sampling line 42 or its open end, could be disposed within the drying drum 33, or at some other component upstream of the dryer exhaust duct 34. Alternatively, the sampling line 42 or its open end, could be located at a component downstream of the dryer exhaust duct 34. The sampling end could also be located away from the dryer exhaust air.

[0011] FIG. 3 is a schematic of the preferred embodiment dryer system 10 according to the present invention. As noted, the dryer system 10 comprises the dryer control unit 20, the dryer 30, the particle counter device 40, and the measuring sample pump 50. Dryer operation is controlled by one or more analog or digital control signals 22 between the dryer control unit 20 and the dryer 30.

[0012] The particle counter device 40 is configured with the dryer 30 so that an air sample is drawn from the exhaust duct 34 of the dryer 30 to the particle counter device 40 through the sampling line 42. Such sample transfer is preferably accomplished by providing the measuring sample pump 50 along a second sampling line 44 as illustrated in FIG. 3. Accordingly, operation of the measuring sample pump 50 draws air through the sampling lines 42 and 44 and thus into the particle counter device 40 whereby particulate level measurements are performed. The sampling lines 42 and 44 are preferably formed from 0.25" stainless steel tubing.

[0013] As further illustrated in FIG. 3, it is preferred that the particle counter device 40 provides an analog or digital output signal 46 representative of the level of particulates being measured. Such signal 46 is preferably directed to the dryer control unit 20 wherein it is utilized to control the operation of the dryer 30. In addition, it is preferred that the measuring sample pump 50 be remotely actuated through a switching signal 52 as noted in FIG. 3. Preferably, the dryer control unit 20 can initiate and terminate operation of the measuring sample pump 50 via the pump switching signal 52.

[0014] The particle counter 40 can be nearly any type of particle counter known to those skilled in the art. It is preferred to utilize a laser-based particle counter. The particle counter selected preferably has a sensitivity sufficient to measure the particulate levels in typical control rooms and microelectronic manufacturing and assembly facilities, and so should be operable at the expected use conditions. The particle counter 40 should be able to detect and measure the concentration of particles as small as about 0.5 microns. A preferred particle counter is available from MET-One, Part No. R 4915. Instead of utilizing an integral particle counter wherein an air sample is transferred to the particle counter and measurements and analytical analyses are conducted within a single instrument enclosure, it is also envisioned to utilize a component-based particle counter system. Such a system may utilize a sensor and/or counter device disposed near the location at which a sample is withdrawn and utilize separately located circuitry and other components for performing analytical functions. Furthermore, the present invention includes embodiments in which the particle counter device is disposed directly in the dryer exhaust duct or the drying chamber and the sampling tube is eliminated. In these embodiments not utilizing a sampling tube, the sample port may be directly incorporated with the particle counter device.

[0015] It is contemplated that a wide array of measuring sample pumps can be utilized for the pump 50 in the preferred embodiment dryer system 10 of the present invention. An example of a suitable pump is a vacuum pump available from Gast, Part No. 0323-101Q-G582 DX supplying 66 cm (26 inches) of suction at 28.32 dm³ pro Minute (one cubic foot per minute). Other devices providing sufficient suction are suitable for use.

[0016] The present invention also includes an optional sampling configuration in which one or more samples of the air stream entering or directed to the dryer are taken, and the concentration of particulates measured. As previously noted, inlet air to a clean room dryer is extensively filtered. An additional check or safeguard against particulate contaminants collecting on clean room garments can be made by sampling the dryer inlet air before and during dryer operation. This optional sampling operation would identify a loss in airstream cleanliness, such as resulting from filter failure or leaks in the
This optional sampling system comprises a sampling tube, such as the previously described sampling line 42, disposed either in the dryer air inlet, or in the inlet air passageway. The sampling tube is connected to a sample pump, such as the previously noted sample pump 50. The same sample pump 50 as is used in the preferred embodiment exhaust air sensing system may be used for withdrawing a sample of inlet air if appropriate valving is employed. An electrically operated solenoid valve and panel mounted switch may be used to select from which sampling line the sample pump 50 is to withdraw a sample, i.e. the sampling tube on the dryer air inlet or the sampling line 42 on the dryer exhaust. The samples are then transferred to the particle counter and measurements of the concentration of particulates made. If such an optional dryer air inlet sensing system is used, it is preferred that the particle counter employ provisions for producing an output representative of the amount of particulates in the inlet air.

The operation of the dryer and particle counter system in accordance with the present invention is generally as follows. Typically, upon placement of garments or other items to be dried in the dryer, e.g. the dryer drum, the dryer is activated and the drying operation begins. This typically involves directing heated air through the drying chamber. At some designated moment, either before, during, or after completion of the drying cycle, the particle counter system is actuated and measurements are taken of the concentration of particulates in the drying chamber or optionally, of air entering the dryer. The operation of the optional sampling of incoming air to the dryer is explained below. As noted, the particle counter can be activated at any time relative to the drying cycle. That is, the particle counter can be initiated and particulate measurements taken upon start-up and initiation of the drying cycle. Alternatively, the particle counter can be initiated at some point during the drying cycle before completion of the drying cycle. Alternatively, the particle counter can be activated at the time of drying cycle completion. It is also contemplated that the particle counter could be initiated at some point after the drying cycle has been completed.

Once actuated, measurements are taken of air samples withdrawn from the drying chamber, or of air having passed through the drying chamber. The measurements of particulate concentration in the air samples are compared to a setpoint value which typically is a predetermined value or a desired level of particulates. The setpoint value may either be stored by the particle counter system or the dryer controller, or input by an operator. If the measured level of particulates exceeds the setpoint value, the drying cycle, or at least passage of clean filtered air through the drying cycle, is continued. Periodic measurements are taken which are compared to the setpoint value. When the measured level of particulates is equal to or less than the setpoint value, a shut down procedure is performed. This may be carried out in conjunction with an indication of such condition. Recognition of reaching the setpoint value may be performed by other methods such as utilizing statistical sampling techniques or cumulative totalizing of measured particulate levels.

As noted, an optional sampling of the inlet air to the dryer may be made and analyzed by the particle counter. Such an operation is performed as follows. A sample of the dryer inlet air is taken, which if utilizing a single sampling pump, is performed by switching sampling lines to which the sampling pump is connected if necessary, so that the pump can withdraw from the inlet airstream. One or more samples of the inlet air are then taken and subsequent measurement made by the particle counter to confirm that the dryer inlet air is at an appropriate cleanliness level. One or more visual or audio indicators may be used to indicate that such condition has, or has not, been met.

FIG. 4 is a block flow diagram illustrating the preferred operation of the dryer system 10 according to the present invention. After garments, body suits, or other clothing, such as for clean room application have been washed, the garments are transferred to the dryer system 10 of the present invention. The garments are then dried to a desired moisture level, i.e. such level typically being preset and monitored by controls known in the art. The previously described optional dryer inlet air particulate measurement operation may be performed before or during the dryer operation. Once the drying cycle has been completed, or the desired level of moisture reached indicating such dryness, an air tumble cycle is initiated in which clean filtered air is circulated over the garments in the dryer 30. If not already activated, such as from the optional dryer inlet air analysis, initiation of the air tumble cycle also preferably activates the particle counter 40 and the measuring sample pump 50. As clean filtered air is circulated over the garments, the measuring sample pump 50 withdrawing a sample of dryer exhaust air from the exhaust air duct 34 through the sampling line 42 into the particle counter device 40. The particle counter 40 measures the particulate level in the dryer exhaust air and generates an output signal 46 to the dryer control unit 20. Previously or concurrently, the operator preferably enters the desired particulate level setpoint designated herein as "SP" into the dryer control unit 20 which is compared with the output signal from the particle counter device 40, designated herein as "M" and representative of the measured particulate level. If the measured particulate level M is greater than the previously entered or desired particulate level setpoint SP, circulation of clean air over the garments is continued and the circulation cycle is repeated. It may be desirable to provide an indication if this cycle is repeated an excessive number of times, such as more than five times. During the circulation of clean air over garments, the particle counter device 40 continues to measure the particulate level from the dryer exhaust 34 and generates a corresponding output signal 46 to the dryer control unit.
20. Once the measured particulate level M is equal to or less than the particulate level setpoint SP, the dryer control unit 20 terminates the circulation cycle and provides a signal or indication that the drying cycle is completed.

[0022] In an alternate embodiment dryer system 12 illustrated in FIG. 5, the dryer system 12 comprises a dryer 30 and a control unit 20, and a remotely located particle counter 40 and sample pump 50. All components are generally as previously described. In this alternate embodiment, the particle counter 40 and sample pump 50 are located within a clean room or other similar facility. This alternate embodiment may be desirable for applications involving an existing clean room, already having particulate measuring instruments, retrofitted with a clean room garment laundry or drying area or device. In order to facilitate connection between the components, one or more sample line connectors or conduits 62, and one or more electrical connectors 64 can be utilized. Such connectors 62 and 64 are preferably installed in a clean room barrier wall 60, and prevent entry of pollutants into the clean room.

[0023] The present invention includes other configurations for remotely locating the particle counter 40 and supporting components, besides that illustrated in FIG. 5. For instance, the measuring sample pump 50 could be located in another area besides the clean room, and/or the control unit 20 could be located in the clean room.

[0024] In all of the foregoing embodiments, it may be necessary to provide one or more cooling means for the exhaust sampling line 42. Such means may include, but not limited to cooling coils, one or more heat exchangers, and cooling devices such as refrigerators. Many manufacturers and suppliers of particle counter devices recommend that the units not be exposed to temperatures greater than 26.7°C (80°F) or receive air samples having temperatures greater than 26.7°C (80°F). Since the temperature of dryer exhaust air is typically greater than 80°F, it will in most instances be necessary to cool the air sample before directing it to the particle counter.

[0025] Moreover, the present invention includes the use of multiple or redundant components including particle counters 40. For instance, a dryer system similar to the previously described dryer systems 10 and 12 could utilize a plurality of particle counters 40. The output signals 46 from each could be averaged or otherwise treated for subsequent controlling and indicating functions. Additionally, the use of multiple sample ports are contemplated such as one or more disposed within a drying drum and/or one or more within a dryer exhaust duct.

[0026] Although the present invention has been described primarily in terms of a tumbler dryer, it is to be understood that the present invention may be embodied in other types of dryers. Furthermore, it is to be understood that the invention includes devices in addition to dryers, or devices that supply a stream of air or other gases over items to be dried.

Claims

1. An apparatus (10) for removing particulates from garments to a desired particulate level, said apparatus comprising:

   a chamber (33) for receiving garments containing particulates, means for passing an air flow through said chamber (33) and proximate to said garments whereby particulates are removed by said air flow through said chamber (33);

   a controller (20) for governing the operation of said apparatus; and

   a particle counter assembly (40) comprising a sample port in communication with said air flow through said chamber (33), and provisions for producing an output representative of the amount of particulates in said chamber, characterized in that said output of said particle counter assembly (40) is utilized by said controller (20) to operate said apparatus until particulates have been removed from garments to said desired particulate level.

2. The apparatus according to claim 1, characterized by:

   an exhaust duct (34) in communication with said chamber (33), said exhaust duct (34) serving to direct said air flow through said chamber out of said chamber, wherein said sample port of said particle counter assembly (40) is disposed along a wall of said exhaust duct (34).

3. The apparatus according to claim 1 or 2, characterized by a fan and motor assembly for providing said air flow through said chamber.

4. The apparatus according to that claim 1 or 3, characterized by said apparatus is a tumbler dryer and said chamber (33) includes a rotatable drum having means for receiving and tumbling garments disposed therein.

5. The apparatus according to claim 1 or 4, characterized by a sample pump (50) in communication with said particle counter assembly (40) wherein said sample pump (50) assists in transferring a sample of said air flow through said chamber (33) to said particle counter assembly (40).

6. The apparatus according to claim 1 characterized by a cooling means disposed between said sample port and said particle counter assembly (40).

7. The apparatus according to claim 1 or 5, characterized by said particle counter assembly (40) com-
prises a laser-based particle counter.

8. The apparatus according to claim 1 characterized by said chamber (33) includes an air inlet and said particle counter assembly further comprises a second sample port in communication with air passing through said inlet.

9. The apparatus according to claim 8 characterized by said particle counter assembly (40) further comprises provisions for producing an output representative of the amount of particulates in said air flow through said inlet.

10. The apparatus according to claim 8 characterized by said particle counter assembly (40) is remotely located from said chamber.

11. The apparatus according to claim 1 further comprising:

an inlet duct in communication with said chamber (33), said inlet duct defining an air inlet sampling port, said particle counter assembly (40) further having a sample port in communication with said inlet duct for withdrawing a sample of air in said inlet.

12. The apparatus according to claim 1 or 5, characterized by said particle counter assembly (40) further has a sampling tube disposed in an exhaust duct for said air flow and extending from a wall of said exhaust duct (34) toward the interior of said exhaust duct (34), said sampling tube obtaining a sample of said air flow from said chamber (33) and directing said sample toward a particle measuring portion of said particle counter assembly (40).

13. A method for controlling the operation of a tumbler dryer (30) to achieve a desired concentration of particulates associated with garments disposed in said dryer, said dryer comprising a rotatable drum (33) for receiving said garments, a particle counter (40) in communication with said drum, means for passing an air flow through said drum, and a control unit (20) having data storage provisions enabling one or more control parameters to be input and stored by said control unit (20), said method comprising:

placing said garments in said drum;

designating a first signal in said control unit representative of a desired concentration of particulates associated with said garments;

passing said air flow through said drum (33) and over said garments; measuring concentration of particulates in said air flow by use of said particle counter (40);

generating a second signal representative of the measured particulate concentration;

comparing said second signal representing measured concentration of particulates in said air flow with said first signal representing desired particulate concentration; and
determining if said second signal is greater than said first signal and if so, then repeating at least said step of passing said air flow through said drum (33), and if not, then initiating a shut down sequence.

14. The method according to claim 13, characterized by said shut down sequence comprises at least one of the following steps:

ceasing passing said air flow through said drum (33), and indicating desired level of particulates has been reached.

Patentansprüche

1. Vorrichtung (10) zum Entfernen von Teilchen aus Wäschestücken bis zu einer Soll-Teilchenkonzentration, wobei die Vorrichtung

eine Kammer (33) zur Aufnahme von Wäschestücken, die Teilchen enthalten, Einrichtungen zum Führen eines Luftstromes durch die Kammer (33) und unmittelbar zu den Wäschestücken, wodurch Teilchen durch den Luftstrom durch die Kammer (33) entfernt werden;
eine Steuereinheit (20) zur Regelung des Betriebes der Vorrichtung und
eine Teilchenzähleinheit (40) umfaßt, die einen Probenöffnung, die in Verbindung mit dem Luftstrom durch die Kammer (33) steht, und Verkehrungen zur Erzeugung eines Ausgangssignals umfaßt, das die Menge der Teilchen in der Kammer (40) darstellt, dadurch gekennzeichnet, daß das Ausgangssignal der Teilchenzähleinheit (40) durch den Steuereinheit (20) verwendet wird, um die Vorrichtung zu betreiben, bis Teilchen aus den Wäschestücken bis zu der Soll-Teilchenkonzentration entfernt sind.

2. Vorrichtung nach Anspruch 1, gekennzeichnet durch einen Abgaskanal (34), der in Verbindung mit der Kammer (33) steht, wobei der Abgaskanal (34) dazu dient, den Luftstrom durch die Kammer aus der Kammer zu leiten, wobei die Probenöffnung der Teilchenzähleinheit (40) längs einer Wand des Abgaskanals (34) angeordnet ist.

3. Vorrichtung nach Anspruch 1 oder 2, gekennzeichnet durch eine Ventilator- und Motoreinheit zum Bereitstellen des Luftstromes durch die Kammer.

4. Vorrichtung nach Anspruch 1 oder 3, dadurch ge-
kennzeichnet, daß die Vorrichtung ein Trommelwäschetrockner ist und die Kammer (33) eine rotierbare Trommel mit Einrichtungen zur Aufnahme und Schleudern von darin befindlichen Wäschestücken einschließt.

5. Vorrichtung nach Anspruch 1 oder 4, gekennzeichnet durch eine Probenpumpe (50), die in Verbindung mit der Teilchenzählereinheit (40) steht, wobei die Probenpumpe (50) dabei hilft, eine Probe des Luftstromes durch die Kammer (33) zu der Teilchenzählereinheit zu überführen.

6. Vorrichtung nach Anspruch 1, gekennzeichnet durch eine Kühleinrichtung, die zwischen der Probenöffnung und der Teilchenzählereinheit (40) angeordnet ist.

7. Vorrichtung nach Anspruch 1 oder 5, dadurch gekennzeichnet, daß die Teilchenzählereinheit (40) einen Teilchenzähler auf Laserbasis umfaßt.

8. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Kammer (33) einen Lufteinlaß einschließt und die Teilchenzählereinheit weiterhin eine zweite Probenöffnung, die in Verbindung mit der Luft, die den Einlaß passiert, steht, umfaßt.

9. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß die Teilchenzählereinheit (40) weiterhin Vorkehrungen zur Erzeugung eines Ausgangssignals, das die Menge der Teilchen in dem Luftstrom durch den Einlaß darstellt, umfaßt.

10. Vorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß die Teilchenzählereinheit (40) entfernt von der Kammer angeordnet ist.

11. Vorrichtung nach Anspruch 1, wobei sie weiterhin einen Einlaßkanal, der in Verbindung mit der Kammer (33) steht, umfaßt, wobei der Einlaßkanal eine Lufteinlaß-Probenentnahmeöffnung bestimmt, wobei die Teilchenzählereinheit (40) weiterhin eine Probenöffnung, die in Verbindung mit dem Einlaßkanal steht, zur Entnahme einer Luftprobe in dem Einlaß aufweist.

12. Vorrichtung nach Anspruch 1 oder 5, dadurch gekennzeichnet, daß die Teilchenzählereinheit (40) weiterhin ein Probenentnahmerohr aufweist, das in einem Abgaskanal für den Luftstrom angeordnet ist und sich von einer Wand des Abgaskanals (34) zum Inneren des Abgaskanals (34) erstreckt, wobei das Probenentnahmerohr eine Probe des Luftstromes aus der Kammer (33) entnimmt und die Probe zu einem Teilchenmeßabschnitt der Teilchenzählereinheit (40) führt.

13. Verfahren zur Steuerung des Betriebs eines Trommelwäschetrockners (30), um eine Sollkonzentration an Teilchen zu erreichen, die mit Wäschestücken verbunden sind, die sich in dem Trockner befinden, wobei der Trockner eine rotierbare Trommel (33) zur Aufnahme der Wäschestücke, einen Teilchenzähler (40), der in Verbindung mit der Trommel steht, Einrichtungen zum Führen eines Luftstroms durch die Trommel und eine Steuereinheit (20) umfaßt, die Datenspeicherungsvorkehrungen aufweist, die es ermöglichen, einen oder mehrere Steuerparameter durch die Steuereinheit (20) aufzunehmen und zu speichern, wobei das Verfahren das Einbringen der Wäschestücke in die Trommel;

das Bestimmen eines ersten Signals in der Steuereinheit, das eine Sollkonzentration an Teilchen, die mit den Wäschestücken verbunden sind, darstellt;

das Führen des Luftstromes durch die Trommel (33) und über die Wäschestücke;

das Messen der Konzentration an Teilchen in dem Luftstrom unter Verwendung des Teilchenzählers (40);

das Erzeugen eines zweiten Signals, das die gemessene Teilchenkonzentration darstellt;

das Vergleichen des zweiten Signals, das die gemessene Konzentration an Teilchen in dem Luftstrom darstellt, mit dem ersten Signal, das die Sollteilchenkonzentration darstellt; und

das Ermitteln, wenn das zweite Signal größer als das erste Signal ist, und wenn das so ist, dann Wiederholen zumindest des Schrittes Führen des Luftstromes durch die Trommel (33), und wenn nicht, dann Einleiten einer Schlußsequenz, umfaßt.

14. Verfahren nach Anspruch 13, dadurch gekennzeichnet, daß die Schlußsequenz zumindest einen der folgenden Schritte umfaßt:

Beenden des Führens des Luftstromes durch die Trommel (33) und Anzeigen, daß die Sollkonzentration an Teilchen erreicht worden ist.

Revendications

1. Dispositif (10) destiné à éliminer des particules de vêtements jusqu’à un niveau de particule souhaité, ledit dispositif comprenant :

une chambre (33) destinée à recevoir des vêtements contenant des particules, un moyen destiné à faire passer une circulation d’air au travers de ladite chambre (33) et à proximité des vêtements d’où il résulte que les particules sont éliminées par la circulation d’air au travers de ladite chambre (33),
Dispositif selon la revendication 1 ou 3,
4.
Dispositif selon la revendication 1,
5.
Dispositif selon la revendication 1 ou 5,
7.
Dispositif selon la revendication 1,
8.
Dispositif selon la revendication 1, caractérisé par :

un conduit de sortie (34) en communication avec ladite chambre (33), ledit conduit de sortie (34) servant à diriger ladite circulation d’air au travers de ladite chambre hors de ladite chambre, dans lequel ledit orifice d’échantillonnage dudit ensemble de compteur de particules (40) est disposé le long d’une paroi dudit conduit de sortie (34).

3. Dispositif selon la revendication 1 ou 2, caractérisé par un ensemble de ventilateur et de moteur destiné à fournir ladite circulation d’air au travers de ladite chambre.

4. Dispositif selon la revendication 1 ou 3, caractérisé en ce que ledit dispositif est un sécheur à tambour et en ce que ladite chambre (33) comprend un tambour rotatif comportant un moyen destiné à recevoir et à faire tourner des vêtements disposés dans celui-ci.

5. Dispositif selon la revendication 1 ou 4, caractérisé par une pompe d’échantillonnage (50) en communication avec ledit ensemble de compteur de particules (40), dans lequel ladite pompe d’échantillonnage (50) aide à transférer un échantillon de ladite circulation d’air au travers de ladite chambre (33) vers ledit ensemble de compteur de particules (40).

6. Dispositif selon la revendication 1, caractérisé par un moyen de refroidissement disposé entre ledit orifice d’échantillonnage et ledit ensemble de compteur de particules (40).

7. Dispositif selon la revendication 1 ou 5, caractérisé en ce que ledit ensemble de compteur de particules (40) comprend un compteur de particules à base de laser

8. Dispositif selon la revendication 1, caractérisé en ce que ladite chambre (33) comprend une entrée d’air et en ce que ledit ensemble de compteur de particules comprend en outre un second orifice d’échantillonnage en communication avec l’air passant au travers de ladite entrée.

9. Dispositif selon la revendication 8, caractérisé en ce que ledit ensemble de compteur de particules (40) comprend en outre des dispositions destinées à produire une sortie représentative de la quantité de particules dans ladite circulation d’air au travers de ladite entrée.

10. Dispositif selon la revendication 8, caractérisé en ce que ledit ensemble de compteur de particules (40) est situé de façon éloignée par rapport à ladite chambre.

11. Dispositif selon la revendication 1, comprenant en outre : un conduit d’entrée en communication avec ladite chambre (33), ledit conduit d’entrée définissant un orifice d’échantillonnage d’entrée d’air, ledit ensemble de compteur de particules (40) comportant en outre un orifice d’échantillonnage en communication avec ledit conduit d’entrée destiné à prélever un échantillon d’air dans ladite entrée.

12. Dispositif selon la revendication 1 ou 5, caractérisé en ce que ledit ensemble de compteur de particules (40) comporte en outre un tube d’échantillonnage disposé dans un conduit de sortie destiné à ladite circulation d’air et s’étendant depuis une paroi dudit conduit de sortie (34) en direction de l’intérieur dudit conduit de sortie (34), ledit tube d’échantillonnage obtenant un échantillon de ladite circulation d’air provenant de ladite chambre (33) et dirigeant ledit échantillon en direction d’une partie de mesure de particules dudit ensemble de compteur de particules (40).

13. Procédé destiné à commander le fonctionnement d’un sécheur à tambour (30) en vue d’obtenir une concentration souhaitée de particules associées à des vêtements disposés dans ledit sécheur, ledit sécheur comprenant un tambour rotatif (33) destiné à recevoir lesdits vêtements, un compteur de particules (40) en communication avec ledit tambour, un moyen destiné à faire passer une circulation d’air au travers dudit tambour, et une unité de commande (20) comportant des dispositions de mémorisation de données permettant qu’un ou plusieurs paramètres de commande soient appliqués en entrée et mémorisés par ladite unité de commande (20), ledit procédé comprenant :
le placement desdits vêtements dans ledit tambour,
l'indication d'un premier signal dans ladite unité de commande représentatif d'une concentration souhaitée de particules associées auxdits vêtements,
le passage de ladite circulation d'air au travers dudit tambour (33) et sur lesdits vêtements,
la mesure de la concentration en particules dans ladite circulation d'air grâce à l'utilisation dudit compteur de particules (40),
la génération d'un second signal représentatif de la concentration en particules mesurée,
la comparaison dudit second signal représentant la concentration en particules mesurée dans ladite circulation d'air audit premier signal représentant la concentration souhaitée en particules, et
la détermination du fait que ledit second signal est plus grand que ledit premier signal et si c'est le cas, la répétition alors d'au moins ladite étape consistant à faire passer ladite circulation d'air au travers dudit tambour (33), et si ce n'est pas le cas, démarrer alors une séquence d'extinction.

14. Procédé selon l'une des revendications 13, caractérisé en ce que ladite séquence d'extinction comprend au moins l'une des étapes suivantes :

la cessation du passage de ladite circulation d'air au travers dudit tambour (33), et l'indication que le niveau souhaité de particules a été atteint.
FIG. 4