

Method for Calculating Life of Filter Screen of Air Purifier, Storage Medium, and Air Purifier

Technical Field

[0001] The disclosure belongs to the technical field of air purification and particularly relates to a method for calculating life of a filter screen of an air purifier, a storage medium, and the air purifier.

Background

[0002] A smart air purifier is a product capable of adsorbing, decomposing or converting various air pollutants to effectively improve the air cleanliness. However, in the traditional art, for air purifier products produced by companies such as American IQARE, Swiss BLUEAR, Philips, domestic Midea, Mfresh and etc., life of the filter screen on the product is usually monitored and calculated by way of countdown. However, for different usage environments, for example, in regions with severe haze in Beijing and Shanghai, the service life of the filter screen will be shortened greatly. In regions with better air, the service life of the filter screen will be very increased greatly. The service life of the filter screen cannot be obtained accurately by way of countdown simply. Moreover, if the filter screen is in the in regions with severe haze for a long time, the service life of the filter screen will be terminated in advance, the filter screen with terminated life is unable to purify air, but a client cannot know this situation timely to replace the filter screen.

Summary

[0003] An object of the disclosure is to provide a method for calculating life of a filter screen of an air purifier, a storage medium, and the air purifier to solve the problem proposed in the background art.

[0004] To achieve the above object, the disclosure uses the following technical solution: a method for calculating life of a filter screen of an air purifier includes the following steps: starting, by the air purifier, counting from start time, setting unit calculating time T_t , setting a plurality of particulate matter concentration ranges $a_1, a_2 \dots a_n$ end to end, and recording a particulate matter concentration C_T in current air at a final node of each unit calculating time;

[0005] judging a particulate matter concentration range a_i where the particulate matter concentration C_T in current air is, wherein the a_i is a group of parameters in $a_1, a_2, \dots, a_n$, and a calculating formula of the consumed life within the unit calculating time of the filter screen is as follows:

[0006] $T_1 = W_i * T_i$

[0007] a calculating formula of residual life of the filter screen is as follows:

[0008] $T_2 = T - T_1$

[0009] in the above calculating formulae, T is maximum total life of the filter screen, T_1 is the life of the filter screen consumed within the unit calculating time, T_2 is the residual life of the filter screen, W_i is a weighted weight coefficient for calculating the life of the filter screen, and a numerical value of W_i is set corresponding to the particulate matter concentration range a_i .

[0010] Preferably, the weighted weight coefficient for calculating the life of the filter screen includes $W_1, W_2, \dots, W_n$, the W_i is a group of parameters in the $W_1, W_2, \dots, W_n$, and the weighted weight coefficient W_i for calculating the life of the filter screen is an influence set weight generated by other influence factors, including a rotating speed of the purifier, air humidity, and an air temperature or an air pressure.

[0011] Preferably, the corresponding method for acquiring the weighted weight W_i for calculating the life of the filter screen in a case that the filter screen is at the particulate matter concentration range a_i includes:

[0012] S11: a_i including at least two value ranges a_1 and a_2 , W_n being provided with at least two values W_1 and W_2 corresponding to a_i , the rotating speed of the purifier including at least one fixed value v_1 , and obtaining a maximum life set of the filter screen under conditions of different air temperatures, different air humidity or different air pressures by way of controlling a single variable in a case that the particulate matter concentration range is a_1 and the rotating speed of the purifier is v_1 ;

[0013] S12: obtaining a weighted average of the life of the filter screen within the concentration range a_1 by a method of weighted mean, and setting a weighted weight W_1 for calculating the life of the filter screen as 1 in a case that the particulate matter concentration is in the range a_1 at the moment by taking the life of the filter screen in this case as a control group;

[0014] S13: in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$, obtaining the maximum life set of the filter screen by way of controlling the single variable in a case that the particulate matter concentrations are in different ranges when the purifier is at different rotating speeds, different air temperatures, and different air humidity or in different air pressure conditions;

[0015] S14: selecting the maximum life set of the filter screen in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$, obtaining a weighted average of the life set of the filter screen by a method of weighted mean in a case that the particulate matter concentration ranges are respectively $a_2, a_3 \dots a_n$, and using the weighted average of the life of the filter screen in each particulate matter concentration range as experimental group data; and

[0016] S15: performing a division operation on the weighted average of the life of the filter screen in the control group and the weighted average of the life of the filter screen in the experimental group to obtain numerical values of the weighted weight W_i for calculating the life of the filter screen in different particulate matter concentration ranges.

[0017] Preferably, in the process of obtaining the control group and the experimental group by the variable control method, the controlled variables are sampled by way of stratified sampling or systematic sampling.

[0018] Preferably, a select range of the air temperature is 0-50°C, a select range of the air humidity is 30-90%, and a select range of the air pressure is 700-1050 hPa.

[0019] A storage medium has a computer program stored therein, and when executed by a processor, the program implements the method for calculating life of a filter screen of an air purifier.

[0020] An air purifier is equipped with the storage medium, specifically including a purifier body and a filter screen disposed in the purifier body, where an infrared sensor or a laser sensor for detecting a concentration of particulate matters in air in a current environment is installed at an air inlet of the purifier body.

[0021] The disclosure has the following beneficial effects: the disclosure provides a dynamic method for calculating life of a filter screen of an air purifier; in a case that the method provided by the disclosure is used to calculate the service life of the filter screen of the air purifier, when the air quality is good, the filter screen of the air purifier will be used for a longer time, and when the air quality is poor, the service life of the filter screen of the air purifier will be shortened; thus, the service life of the filter screen can be effectively detected, so that situations that the filter screen is scrapped and replaced or the filter screen has reached the service life when there are few particulate matters filtered by the filter screen but the total filtering duration is expired, and the filter screen is ineffectively used continuously as the total filtering duration is not expired are avoided;

[0022] Besides, according to the method for calculating service life of a filter screen illustrated by the disclosure, during production of the air purifier and the supporting filter screen, the weighted weights W_n for calculating the service life of the filter screen within different particulate matter concentration ranges can be obtained by experimenting samples. Thus, in a case that a computer readable storage medium on the air purifier body stores and calculates the data of the service life of the filter screen, a multiplication on the weighted weights W_n for calculating the service life of the filter screen within different particulate matter concentration ranges and where the particulate matter concentration C_T in the current air is and the unit calculating time T_t is only performed within each unit calculating time T_t to obtain the service life of the filter screen consumed within the unit calculating time T_t . The operation features few processes and a small operation amount of the computer program. Therefore, the computer readable storage medium with low cost can be used, so that the production cost of the whole air purifier product is effectively lowered. The number of experiments can be effectively reduced greatly by sampling variables by way of stratified sampling or systematic sampling. The selected air temperature, air humidity, and air pressure ranges are range values of a human normal living environment.

Brief Description of Figures

[0023] FIG. 1 is a flowchart of a method for acquiring a weighted weight W_i for calculating life of a filter screen corresponding to each particulate matter concentration range a_n ; and

[0024] FIG. 2 is an exposed view of an arithmetic logic of a computer readable storage medium using the method provided by the disclosure.

Detailed Description

[0025] The preferred embodiment of the disclosure is described in detail below in combination with drawings to make advantages and features of the disclosure more easily understood by those skilled in the art, so that the protection scope of the disclosure is more clearly and specifically defined.

[0026] Embodiment:

[0027] A method for calculating life of a filter screen of an air purifier includes the following steps: starting, by the air purifier, counting from start time, setting unit calculating time T_t , setting a plurality of particulate matter concentration ranges $a_1, a_2 \dots a_n$ end to end, and recording a particulate matter concentration C_T in current air at a final node of each unit calculating time;

[0028] judging a particulate matter concentration range a_i where the particulate matter concentration C_T in current air is, wherein the a_i is a group of parameters in $a_1, a_2 \dots a_n$, and a calculating formula of the consumed life within the unit calculating time of the filter screen is as follows:

[0029] $T_1 = W_i * T_t$

[0030] a calculating formula of residual life of the filter screen is as follows:

[0031] $T_2 = T - T_1$

[0032] in the above calculating formulae, T is maximum total life of the filter screen, T_1 is the life of the filter screen consumed within the unit calculating time, T_2 is the residual life of the filter

screen, W_i is a weighted weight coefficient for calculating the life of the filter screen, and a numerical value of W_i is set corresponding to the particulate matter concentration range a_i ;

[0033] the weighted weight coefficient for calculating the life of the filter screen includes $W_1, W_2 \dots W_n$, the W_i is a group of parameters in the $W_1, W_2 \dots W_n$, and the weighted weight coefficient W_i for calculating the life of the filter screen is an influence set weight generated by other influence factors, including a rotating speed of the purifier, air humidity, and an air temperature or an air pressure; the corresponding method for acquiring the weighted weight W_i for calculating the life of the filter screen in a case that the filter screen is at the particulate matter concentration range a_i includes:

[0034] S11: a_n including at least two value ranges a_1 and a_2 , W_n being provided with at least two values W_1 and W_2 corresponding to a_n , the rotating speed of the purifier including at least one fixed value v_1 , and obtaining a maximum life set of the filter screen under conditions of different air temperatures, different air humidity or different air pressures by way of controlling a single variable in a case that the particulate matter concentration range is a_1 and the rotating speed of the purifier is v_1 ;

[0035] S12: obtaining a weighted average of the life of the filter screen within the concentration range a_1 by a method of weighted mean, and setting a weighted weight W_1 for calculating the life of the filter screen as 1 in a case that the particulate matter concentration is in the range a_1 at the moment by taking the life of the filter screen in this case as a control group;

[0036] S13: obtaining the maximum life of the filter screen in a case that the particulate matter concentrations are in different ranges under different conditions by way of controlling the single variable in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$;

[0037] S14: selecting the maximum life set of the filter screen when the purifier is in the conditions of different rotating speeds, different air temperatures, different air humidity or different air pressures in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$, obtaining the weighted average of the life of the filter screen in the different particulate matter concentration ranges by the method of weighted mean, and using the weighted average of the life of the filter screen in the particulate matter concentration ranges as experimental group data; and

[0038] S15: performing a division operation on the weighted average of the life of the filter screen in the control group and the weighted average of the life of the filter screen in the experimental group to obtain numerical values of the weighted weight W_i for calculating the life of the filter screen at different rotating speeds and in different particulate matter concentration ranges.

[0039] When the above experiment is performed, in the process of obtaining the control group and the experimental group by the variable control method, the controlled variables are sampled by way of stratified sampling or systematic sampling, thereby, not only guaranteeing effectiveness and universality of the data, but also reducing the number of experiments greatly. Moreover, the method for obtaining the weighted values of life data of the purifier at different rotating speeds of the purifier, different air temperatures, different air humidity or different air pressures is as follows:

[0040] it is assumed that the rotating speeds of the purifier include two numerical values v_1 and v_2 , the air temperatures include three numerical values t_1 , t_2 , and t_3 , the humidity intervals include three intervals h_1 , h_2 , and h_3 , and the air pressure intervals include three intervals p_1 , p_2 , and p_3 ; and

[0041] life data of a plurality of groups of air purifiers is obtained by way of controlling the single variable, and for example, by taking the life data of the air purifier with the rotating speed set as v_1 , the air temperature set as t_1 , the humidity set as h_1 , and the air pressure set as p_1 as the control group, control group data of the life of the plurality of groups of air purifiers is obtained by respectively controlling variations of different conditions, and weights in different conditions can be obtained by analyzing a variation trend of the life.

[0042] Referring to table 1, assuming that the life data of the air purifier in a case that each variable is in an interval I is L_1 , other variables are in the interval I; the life data of the air purifier of each variable in each interval is obtained by controlling the variation of the single variable; by controlling a variable degree of the life data of the air purifier, the weight values of the life data of the purifier can be obtained in a case that the variables are in different intervals; for example, assuming that the air temperature interval, the air humidity interval, and the air pressure interval are I, and the rotating speed interval of the air purifier is II, the life data of the air purifier is L_2 and the life decrement of the air purifier is L_1-L_2 ; and assuming that the air humidity interval, the rotating speed interval of the air purifier, and the air pressure interval are I, and the air temperature

interval is II, the life data of the air purifier is L3 and the life decrement of the air purifier is L1-L3, by parity of reasoning; and

[0043] moreover, through $\frac{L1-L2}{(L1-L2)+(L1-L3)} \times L2 + \frac{L1-L3}{(L1-L2)+(L1-L3)} \times L3$, the weighted average can be obtained in a case that the life data is L2 and L3.

[0044] Table 1

Variable	Interval	Life data/day	Interval	Life data/day	Interval	Life data/day
Rotating speed interval of purifier	I	L1	II	L2		
Air temperature interval	I	L1	II	L3	III	L6
Air humidity interval	I	L1	II	L4	III	L7
Air pressure interval	I	L1	II	L5	III	L8

[0045] For example, the rotating speed of the purifier can be set at 450 r/m and 850 r/m, the air temperature includes three intervals 0-15°C, 16-30°C, and 30-50°C, the humidity includes three intervals 30-50%, 50-70%, and 70-90%, and the select range of the air pressure includes three intervals 700-850 hPa, 850-950 hPa, and 950-1050 hPa;

[0046] the life data of the plurality of groups of air purifiers is obtained by way of controlling the single variable, and for example, by taking the life data of the air purifier with the rotating speed set as 450 r/m, the air temperature set as 0-15°C, the humidity set as 30-50%, and the air pressure set as 700-850 hPa as the control group, control group data of the life of the plurality of groups of air purifiers is obtained by respectively controlling variations of different conditions, and weights in different conditions can be obtained by analyzing a variation trend of the life.

[0047] Referring to table 2 and table 1, assuming that the life data of the air purifier in a case that each variable is in an interval I is 100x (x is a coefficient, which can be any value), assuming that the air temperature interval, the air humidity interval, and the air pressure interval are I, and the

rotating speed interval of the air purifier is II, the life data of the air purifier is 65x and the life decrement of the air purifier 35x, and assuming that the air humidity interval, the rotating speed interval of the air purifier, and the air pressure interval are I, and the air temperature interval is II, the life data of the air purifier is 85x and the life decrement of the air purifier is 15x; and

[0048] moreover, through $\frac{35x}{35x+15x} \times 35x + \frac{15x}{35x+15x} \times 15x$, the weighted average is 29x in a case that the life data is L2 and L3.

[0049] Table 2

Variable	Interval	Life data/day	Interval	Life data/day	Interval	Life data/day
Rotating speed interval of purifier	I	100x	II	65x		
Air temperature interval	I	100x	II	85x	III	75x
Air humidity interval	I	100x	II	80x	III	75x
Air pressure interval	I	100x	II	95x	III	93x

[0050] When the above experiment is performed, the select range of the air temperature is 0-50°C, the select range of the air humidity is 30-90%, the air pressure range is 700-1050 hPa, and the range values of the above factors cover most environmental parameters, so that the universality of the weight coefficient W_n for calculating the life of the filter screen can be ensured and obtained. In actual use, the rotating speed of the purifier is an important influence factor. The value of W_i of the purifier at different rotating speeds can be calculated independently without considering the air temperature, air humidity, and air pressure. By taking the air purifier product of this company as an example, in the product, the particulate matter concentration range a_n is divided into four layers,

and specific data of the weighted weight W_n for calculating the life of the filter screen obtained by the above experimental steps is shown in the following table 3:

[0051] Table 3

Air quality index	Particulate matter concentration an (i.e., PM2.5 concentration)	Weighted weight W_n for calculating life of filter screen	Life T_1 consumed within unit calculating time
Excellent	2-15	1	$1s=1s$
Good	16-55	$6/5$	$5s=6s$
Average	56-150	$7/5$	$5s=7s$
Poor	151-999	$8/5$	$5s=8s$

[0052] In table 3, the rotating speed of the purifier is fixed as v_1 , for example, 300 r/min, 450 r/min. In a case that the air quality is good, the weight coefficient W_1 for calculating life of the filter screen is 1, and therefore, for the actual use duration consumed within the unit calculating time, in a case that the air quality is good, the weighted weight W_2 for calculating the life of the filter screen is $6/5$. Therefore, the actual use duration of the filter screen is $5/6$ of the life consumed within the unit calculating time. Since the purifying capacity of the air purifier has the maximum value, a tail end value of the particulate matter concentration range a_4 designed by the product is theoretically infinite. In a case that the air quality index is in other ranges, the life consumed within the unit calculating time is counted and recorded according to the above table. Moreover, in a case that the total use duration of the filter screen is determined, the life of the filter screen consumed within the unit calculating time each time is subtracted from the total use duration of the filter screen to obtain the residual life of the filter screen.

[0053] The embodiment provides an air purifier through the method for calculating service life of a filter screen of an air purifier, including a purifier body and a filter screen disposed in the purifier body, where the infrared sensor or laser sensor for detecting the particulate matter concentration in the air in the current environment is installed at the air inlet of the purifier body; as single detection time of a conventional infrared sensor is usually about 2 minutes, the unit calculating time T_t is the single detection time or a multiple thereof when the infrared sensor is used, and the laser sensor is in a continuous detection status. Therefore, the unit calculating time T_t can be set

when the laser sensor is used, and the particulate matter concentration range an where the used particulate matter concentration value is in within the unit calculating time can be determined by selecting the particulate matter concentration identified at an intermediate moment of each unit calculating time, or the particulate matter concentration range an where the used particulate matter concentration value is in within the unit calculating time can be obtained by selecting the particulate matter concentration values at the head and tail ends of the unit time within each unit calculating time and calculating the mean value of the two concentration values. Of course, with respect to selection of the infrared sensor or the laser sensor, the infrared sensor or the laser sensor has a great difference in cost therebetween, which can be selected voluntarily according to the demand of a manufacturer. Moreover, the embodiment provides a computer readable storage medium, having a computer program stored therein. When executed by a processor, the program implements the method for calculating life of a filter screen of an air purifier in the embodiment. In a case that the computer program calculates the life of the filter screen of the air purifier, first, the concentration C_T of particulate matters collected by the infrared sensor or the laser sensor in the environment at the air inlet of the purifier according to the unit calculating time T_t , then the particulate matter concentration range a_i at the C_T is judged, and then the weighted weight W_i for calculating the life of the filter screen is obtained according to the current particulate matter concentration range a_n , and the life of the filter screen consumed with the unit calculating time can be obtained through a formula $T_1=W_i*T_t$. Moreover, the residual service life of the filter screen can be calculated through the formula $T_2=T-T_1$. The computer program totally executes the following steps: receiving (the particulate matter concentration C_T)-judging (the particulate matter concentration range where the C_T is)-calculating the life of the filter screen consumed within unit time-calculating the residual life of the filter screen. In the above steps, the operation features a simple formula and few operation steps. Therefore, the computer readable storage medium with low cost can be used, so that the production cost of the whole air purifier product is effectively lowered.

[0054] The above is merely embodiments of the disclosure and does not hence limit the patent range of the disclosure. Equivalent structures made by means of the contents of the description and drawings of the disclosure are applied to other related technical fields directly or indirectly, which is, in a similar way, comprised in the protection scope of the patent of the disclosure.

What is claimed is:

1. A method for calculating life of a filter screen of an air purifier, comprising the following steps: starting, by the air purifier, counting from start time, setting unit calculating time T_t , setting a plurality of particulate matter concentration ranges $a_1, a_2 \dots a_n$ end to end, and recording a particulate matter concentration C_T in current air at a final node of each unit calculating time;

judging a particulate matter concentration range a_i where the particulate matter concentration C_T in current air is, wherein the a_i is a group of parameters in $a_1, a_2 \dots a_n$, and a calculating formula of the consumed life within the unit calculating time of the filter screen is as follows:

$$T_1 = W_i * T_t$$

a calculating formula of residual life of the filter screen is as follows:

$$T_2 = T - T_1$$

in the above calculating formulae, T is maximum total life of the filter screen, T_1 is the life of the filter screen consumed within the unit calculating time, T_2 is the residual life of the filter screen, W_i is a weighted weight coefficient for calculating the life of the filter screen, and a numerical value of W_i is set corresponding to the particulate matter concentration range a_i .

2. The method for calculating life of a filter screen of an air purifier according to claim 1, wherein the weighted weight coefficient for calculating the life of the filter screen comprises $W_1, W_2 \dots W_n$, the W_i is a group of parameters in the $W_1, W_2 \dots W_n$, and the weighted weight coefficient W_i for calculating the life of the filter screen is an influence set weight generated by other influence factors, comprising a rotating speed of the purifier, air humidity, and an temperature or an air pressure.

3. The method for calculating life of a filter screen of an air purifier according to claim 2, wherein the corresponding method for acquiring the weighted weight W_i for calculating the life of the filter screen in a case that the filter screen is at the particulate matter concentration range a_i comprises:

S11: a_i including at least two value ranges a_1 and a_2 , W_n being provided with at least two values W_1 and W_2 corresponding to a_i , the rotating speed of the purifier including at least one fixed value v_1 , and obtaining a maximum life set of the filter screen under conditions of different air temperatures, different air humidity or different air pressures by way of controlling a single variable in a case that the particulate matter concentration range is a_1 and the rotating speed of the purifier is v_1 ;

S12: obtaining a weighted average of the life of the filter screen within the concentration range a_1 by a method of weighted mean, and setting a weighted weight W_1 for calculating the life of the filter screen as 1 in a case that the particulate matter concentration is in the range a_1 at the moment by taking the life of the filter screen in this case as a control group;

S13: in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$, obtaining the maximum life set of the filter screen by way of controlling the single variable in a case that the particulate matter concentrations are in different ranges when the purifier is at different rotating speeds, different air temperatures, and different air humidity or in different air pressure conditions;

S14: selecting the maximum life set of the filter screen in a case that the particulate matter concentrations are respectively $a_2, a_3 \dots a_n$, obtaining a weighted average of the life set of the filter screen by a method of weighted mean in a case that the particulate matter concentration ranges are respectively $a_2, a_3 \dots a_n$, and using the weighted average of the life of the filter screen in each particulate matter concentration range as experimental group data; and

S15: performing a division operation on the weighted average of the life of the filter screen in the control group and the weighted average of the life of the filter screen in the experimental group to obtain numerical values of the weighted weight W_i for calculating the life of the filter screen in different particulate matter concentration ranges.

4. The method for calculating life of a filter screen of an air purifier according to claim 3, wherein in the process of obtaining the control group and the experimental group by the variable control method, the controlled variables are sampled by way of stratified sampling or systematic sampling.

5. The method for calculating life of a filter screen of an air purifier according to claim 4, wherein a select range of the air temperature is 0-50°C, a select range of the air humidity is 30-90%, and a select range of the air pressure is 700-1050 hPa.
6. A storage medium, using the method for calculating life of a filter screen of an air purifier according to claim 1, wherein the storage medium has a computer program stored therein, and when executed by a processor, the program implements any method for calculating life of a filter screen of an air purifier according to claim 1.
7. An air purifier, equipped with the storage medium according to claim 6, comprising a purifier body and a filter screen disposed in the purifier body, wherein an infrared sensor or a laser sensor for detecting a concentration of particulate matters in air in a current environment is installed at an air inlet of the purifier body.