



## ADEQUATE TEMPERATURE AND HUMIDITY FOR BOOKS AND PEOPLE IN A LIBRARY

**Bang-Lee Chang, Chinese Culture University, Taiwan**  
Email: blchang@sce.pccu.edu.tw

**Hui-chen Lee, Chinese Culture University, Taiwan**  
Email: h3371843@yahoo.com.tw

**Yen-Ku Kuo, Chinese Culture University, Taiwan**  
Email: ykkuo@sce.pccu.edu.tw

**Ying-Yueh Su, Chinese Culture University, Taiwan**  
Email: yysu@sce.pccu.edu.tw

**Ching-Tzu Chen, Chinese Culture University, Taiwan**  
Email: cctju@faculty.pccu.edu.tw

### ABSTRACT

*Taiwan is located in a subtropical zone where there is a lot of moisture during the rainy season or typhoons. In other words, for most of the year, warm and moist climate are two typical features of Taiwan's environment. This kind of climatic conditions (warm temperature and high humidity) create a suitable environment for the growing of bacteria, germ, mold and insects. Besides destroying books, data files stored on electronic support and paper, it also has a serious impact on human health.*

*The experimental and statistical analyses of the results of this study show that factors such as the total number of people in a library, library floor area, time of day and floor position within the building, have not been showing causality with the bacterial colony count (CFU/m<sup>3</sup>).*

*In fact, the subsistence and reproduction of bacteria, germ, mold and insects, has a relation to temperature independent from its relation to humidity in the library environment. This study suggests that the library's administrative staff should set and control optimum temperature and humidity scrupulously. This would not only improve the staff work efficiency but also maintain paper, books and electronic material in appropriate condition. According to the results of this research, the bacterial colony count (CFU/m<sup>3</sup>) presents an increasing trend when rising the temperature in the library; furthermore, the bacterial colony count decreases as the humidity level increases. However, when both temperature and humidity are considered at the same time, then the relationship to the bacterial colony count (CFU/m<sup>3</sup>) has no significance ( $p$  value > 0.05). The optimum indoor temperature range for the library is 20°C ~26°C and the optimum range of relative humidity is 40%~60% RH.*

## GENESIS AND THE PURPOSE

Taiwan is located in the subtropical zone, can get plentiful moisture by rainy season or typhoon. Therefore form and “moist climate environment” and “make warm”. According to the documents and materials <sup>[1]</sup> learn: In the past 100 years (1897- 1997), Average temperature of Taiwan and average relative humidity, differentiate 23 °C and 80% RH. Moreover in the past 10 years according to Central Weather Bureau (2002- 2011) Its statistical data <sup>[2]</sup> is learnt: The average temperature of this island of Taiwan and range of average relative humidity, is 22- 23°C and 77- 79 RH respectively. Temperature and humidity since the past one hundred years of Taiwan in other words, there is no obvious change. Relevant literature point out this kind of temperature is moderate, the climatic conditions of the high humidity, quite suitable for the existence of all kinds of bacteria and multiply <sup>[1]</sup>. Moreover can learn, suspend the respiratory system that the particle will injure the human body in the air with the documents and materials; One is smaller than 5.7 m and suspend the particle pollutant directly, it is apt to initiate breathing problems such as chronic rhinitis, bronchitis, asthma, pneumonia, etc.. Under suspending the surface of particle and absorbing the sulfur dioxide situation, the injury to the human respiratory system will be faster and serious <sup>[3]</sup>. Angry glue of living beings (Bioaerosols), in order to suspend one kind of particles, including: Suspend the microorganism in the air (such as virus, bacterium, fungi, mould) And small particle (such as spore, pollen, biological toxin) comes out by little organism release <sup>[4,5,6]</sup>. These tiny microorganism or small particle can enter the human body via the respiratory tracts as stated above, and then it is healthy to influence the people <sup>[7, 8]</sup>.

Learn, the people exceed 80% in the internal environment activity time of room according to the documents and materials <sup>[9, 10, 11]</sup>. Lance <sup>[12]</sup> also proposed the similar investigation result in 1996, studied and pointed out: General people account for 87.2% of time of total life in the time of internal environment of room, the time of another about 7.2% is used in the traffic, about 5.6% are the time of outdoor sports finally. The gradual progress and industrial and commercial activity grow vigorously, can predict the people will stay and increase in indoor time continuously in the future with era. The mankind needs it by breathing to maintain the life, so the people, to “closely bound up indoor air quality” (Indoor Air Quality, IAQ) Pay attention to more and more. But, from before state it can learn, Taiwan helps to climate the environments it survives and multiply all kinds of microorganisms. So no matter oneself is the harmful to human body angry glue of living beings polluted, the muzzle enters building room directly or with personnel, mechanical ventilation facilities situation of entering room indirectly by making, certainly will can hardly be avoided.

How to improve indoor air quality, it is the people, building staff member and relevant units of government in fact, important subject that must be faced scrupulously. And the library is the place where the people often call on. Understand the angry glue of living beings which influences people's health, exist in the state of the library, find out the indoor factor influencing colony thickness of the library, and propose taking precautions against or improving the countermeasure, and then improve the indoor air quality of the library. Except that can ensure using the people to be healthy in the library, offer it outside the comfortable activity space; Can reach and increase working efficiency it with keeping many projects such as the books or file in the hall properly by improving the indoor surrounding air quality of the library.

Originally study as probing into the factor with different floors, period, place property, area of floor, the number of people of use and projects such as the warm humidity, etc. in the hall separately, and with the “impacted taking a sample device” (Buck, Bio-Culture B30120), Collect library living beings angry glue sample in the air, strike at culture medium that suit directly sample, and then received the indoor colony thickness of the library. Learn influence the main factor of the colony thickness to include with the experimental result and statistical analysis materials: Indoor relative humidity, temperature and place use properties. Enter factors such as the total number of person, area of floor period and height of floor of the hall, etc. have not been showing causality with the colony thickness.

## RETROSPECT OF LITERATURE

### 1 The angry glue of living beings takes a sample in the way

To different uses or all kinds of buildings of ' air quality ' (including living beings angry glue distribution situation) ,Quite a lot of research has discussed with the plan extensively already; Also have periodical thesis coming up to a large number, put forward the penetrating opinion and valuable research results <sup>[13-43]</sup>. Various research results, conclusion and suggestion, the improvement of the air quality of all kinds of place, contribute tall and erectly. This research is summed up and gathered together whole and internationally, experts and scholars who probe into this topic can learn after ever using the research approach, probe into the indoor air quality methods internationally, is mostly probed into by the literature and reviewed beginning, and after putting in order and analyzing relevant materials, with the experiment tactics immediately, collected the angry glue sample of living beings in the air, select the ' culture medium ' suitable for use and train samples. Calculate the angry glue quantity of living beings in culture medium with the microscope afterwards; calculate the angry glue thickness of living beings of 1 m<sup>3</sup> air. Collect method of sample at the experiment, roughly can divide into two, until Shen lower law (CFU / ware) naturally first, In order to strike the law (CFU/ m<sup>3</sup>) the second kind.

Because the angry glue of living beings is not distributed in the space of room evenly, it will change to distribute the state as the air current is changed in time or space. So gather some figure in the position, sample of the angry glue of living beings, time of taking a sample, train the way, sampling method and computing technology, will all influence the accuracy <sup>[13]</sup> of the experimental result. Getting relevant with “Shen lower the law naturally” the two differences:

1. Strike the law: Use and strike the law taking a sample device, it is relatively high to catch the angry glue probability of living beings, comparatively accurate at the time of quantitative analysis. But need special instrument, and take a sample the area is relatively small, time is relatively short that take a sample. Moreover need consider the accuracy of the taking a sample device in addition. For example apparatus correct the issue and maintenance question <sup>[13]</sup>, etc.
2. Shen lowers the law: Generally speaking, Shen fall living beings angry glue total number that law obtain than bump into law to be large naturally. But small living beings angry glue among air, easy to bully, flow, influence more unstable, so unable to control the angry glue of living beings effectively Shen drops to surface of culture medium. Lower the quantity and relate to suspend particle size in angry glue Shenyang of living beings. Learn by experiment Shen fall quantity and microbial particle thickness of air

appears positive correlation. Than bump into law to be loud error to lower law Shen take a sample repeatedly. But Shen lower law take special instrument, easy and simple to handle, take a sample area to be relatively loud. Until “bump into law”, quantity examine the result, the trend is identical <sup>[13]</sup> generally speaking “Shen lower law naturally”.

## 2 Indoor air quality

Because of the angry glue thickness of living beings, is the good and bad important assessment indicator or not of the air quality. And the daily colony thickness of angry glue thickness of living beings is come to weigh. The colony in the air is the taller in thickness, show that there is pathogenic microorganism (such as the bacterium, fungi, virus), small the particle (Such as fungi spore, actinomycetes spore). and the dust). It is the higher, the apteral to initiate respiratory disease to wait for the quantity of the common allergic source. Learn <sup>[13]</sup> according to the literature, influence the factor of the colony thickness in the indoor air, include: Occupy the indoor personnel's density, building and ventilate the situation, day lighting, temperature, humidity, dust content of taking a breath, suspend the diameter size of particle and surrounding environment state etc. Foreign relevant research group, propose the following important conclusions and propose according to the research results:

1. Indoor colony thickness, the winter that summer exceed; Early exceeding noon late; The building exceeds the one-storey house; Exceed the room in the public place, the fire coal gets warm one gets warm in the family more than air conditioner, the dirty air exceeds and cleans the air <sup>[13]</sup> (China's Mainland).
2. Indoor colony thickness  $<1,500 \text{ CFU/m}^3$ , belong to the room of the hygiene with “ordinary” state; Indoor colony thickness  $<2,500 \text{ CFU/m}^3$ , belong to the room of the hygiene with 'slightly bad' state. The patient of waiting room gathers and the quantity is large, in order to ensure clinic people to be healthy, the colony thickness  $<1,000 \text{ CFU/m}^3$  in the fixed air and should be sterilized regularly. Stipulate the colony thickness of office building and hotel  $<1,500 \text{ CFU/m}^3$  <sup>[13]</sup> (China's Mainland).
3. The colony thickness of the hospital  $<1,500 \text{ CFU/m}^3$ , places such as hostel, market, club, theatre, amusement park, subway station, etc. Colony thickness  $<4,000 \text{ CFU/m}^3$ , the colony thickness in the ordinary hotel, hostel air  $<2,500 \text{ CFU/m}^3$ , GB/T18883-2002 indoor air quality standard, stipulate the colony thickness is  $2,500 \text{ CFU/m}^3$  (China's Mainland) <sup>[13]</sup>.
4. Belong to “clean air” colony suggestion of thickness until (bump into law take a sample). Belong to “ordinary air” colony suggestion of thickness until (bump into law take a sample) <sup>[13]</sup>.
5. Indoor colony thickness  $<1,000 \text{ CFU/m}^3$  is an indoor air quality minimum exigency, the condition of the indoor air with good quality is the indoor colony thickness  $<500 \text{ CFU/m}^3$  (Hong Kong) <sup>[14]</sup>.
6. The indoor colony thickness in summer  $\geq 2,500 \text{ CFU/m}^3$  is regarded as the air (the Soviet Union) polluted <sup>[13]</sup>.

Should protect people to be healthy, as well as for really feasible regulation, China's Mainland and Japan, stipulate the suggestion value of the colony thickness in the indoor air tentatively, as shown in Table 1 <sup>[13]</sup>.

Table 1 the air colony thickness advising value (Mainland China and Japan)

The air cleans degree		Sample method	
		Lower the law in Shenyang naturally (CFU / ware)	Strike the law (CFU/ m <sup>3</sup> )
		total number of the colony	
Mainland China	Clean air	≤30	≤1500
	Ordinary air	≤75	≤2500
Japan	Very Clean air	1~2	-
	Clean air	≤30	-
	Ordinary air	31~75	-
	Demarcation line	150	-
	slight pollution	≤300	-
	serious pollution	≥300	-

### 3 The hurting mould with the insect pest of paper books file <sup>[1]</sup>

Deposits in books files such as the literature periodical, file file, historical materials, the magazine prevails and consult the books in the library, etc., mostly paper materials, and paper material is mostly organic fibrous quality materials, then the moisture when will absorb the air results in hydrolyzing and reacting but enable the fibrous degradation. So, the paper material is extremely apt to suffer water damage. Secondly, the paper makes up and contains the mould and carries on the necessary nutrient of metabolism course in materials. Moreover the temperature of Taiwan is suitable, the climatic conditions that many rain is moist are quite suitable for the microorganism (mould) Grow and breed, make the paper books file must be faced ' mouldly and rottenly ' with the question, learnt, save the place, the mould that is often found in the paper quality material by the literature, including: Aspergillu, Penicillium, Trichoderma, Chaetomum, Cladosporium, Fusarium and other such as Mucor, Rhizopus, Stemphylium, Stachybotrys, Alternaria , Often on books place of file of storing (such as library). The bacterium appearing, it is suitable for the warm humidity of growing, as shown in Table 2.

Generally speaking, humidity exceed saturation or have liquid environmental terms, the bacterium could grow and breed; Take yeast as an example, the environment that the yeast grows, its humidity is close to the saturation; Secondly the mould utilizes long hypha, expand and obtain moisture range. Therefore when the relative humidity is higher than 70%, the mould can grow well. In view of the above, the mould becomes the main bacterium in “mould and rotten microorganism”.

Temperature is from 5°C to can all find bacteria under 60°C 70°C environment. The most suitable for the temperature range of growth and lie between at 30°C- 35°C The growth temperature of the mould about 25°C Moreover fungus reproduction or growth still relates to environmental pH, take mould and yeast as an example, suitable for growing under the environment of pH 2 - pH 8, but relatively have a partiality for the acid environment, the most suitable acid soda value is pH 5. And bacterium like fortunately neutral or lean towards soda grow under the environment, most suitable sour soda value pH 7.5 slightly relatively. Learn, cause the “mould and rotten” microorganism making the paper material with rotten degradation with the literature, including the fungi, bacterium and radiating the fungus. Paper a material (such as books and file, etc.). It happen “mould and rotten”, “change color” or “go

bad” should possess by primary condition of three pieces, include: Microorganism exist on room of the internal environment, supply with the nutrient that the microorganism needs (food), suitable and environmental (Temperature, humidity, pH, etc.). So long as destroy any condition into it, can prevent the occurrence of paper books file “mould and rotten”. Generally speaking, prevent the occurrence of paper books file the “mould and rotten” include <sup>[1]</sup>:

1. Isolate the microorganism from books file, prevent happening “mould and rotten”.
2. Control environment warm, humidity properly, prevent the mould from growing.
3. Control the warm humidity strictly: Temperature, under 20°C, relative humidity: under 65%.
4. Use physical technology or chemical method (Medicine is dealt with), eliminate the mould.
5. Use oxidant, reducing agent, and the superficial mould spot or corrupt mark of removing the paper quality by way of rinsing.

Save the warm humidity [1] suitable for the mould and grow in the place with material of paper quality of Table 2.

Table 2 suitable for the mould and grow in the place with material of paper quality <sup>[1]</sup>

genus	species	Suitable for the Temperature and humidity that the mould grows	
		Temperature ( °C )	Relative humidity ( % )
Aspergillus : temperature : middle humidity : 85%, dry live type: 65%	Aspergillus flavus Link	30°C ~38°C	80% ~86%
	Aspergillus niger var.niger	35°C ~37°C Some over 50°C	80% ~88%
Penicillium : temperature : low, under 0°C Can still endanger the parasite humidity : 80% ~88%	Penicillium citrinum Thom	25°C ~30°C Some over 37°C	80% ~85%
	Penicillium chrysogenum Thom	20°C ~25°C Some lower than -4°C	82% ~84%
Trichoderma	Trichoderma viride Pers. ex Gray	Middle temperature	88%
Chaetomium	Chaetomium globosum Kunze	25°C ~30°C	90%
Cladosporium		18°C ~28°C Some lower than -7°C Some over 30°C ~32 °C	88% ~94%
Fusarium		4°C ~32°C	80 % ~100 %

But can't grow up only in order to prevent bacteria or mould, require the paper books file to store the place simply (such as the library) Has adopted the low humidity, because it is apt to make the paper shrink to cross the low humidity, even because the too dry brittle rupture. So propose that should set up the central air system in places such as the stacks, etc., use to regulate the temperature and humidity. Can use the window (case) also for fear of factor of short of moseying, etc. The type air conditioner matches and uses the dehumidifier, reach and keep the permanent wet environment of constant temperature. When it is unable to set up the

air conditioning, storing the place must keep the good ventilation state. Usually suitable temperature: It is 24.4°C-27.7°C in summer, it is 21.1°C in winter; Humidity: It is 40%- 70% RH in summer, it is 20- 50% RH <sup>[44]</sup> in winter.

Except that the microorganism causes danger to the books file in the library, the material also in order to destroy the paper quality of insect is saved to the important members in the place. Pointed out by the literature, even if the insect can enter paper quality materials and save the playground smoothly, want to form the party in groups, must offer its growth and environmental condition bred suitably, just have an opportunity to cause serious danger. And it is suitable for the environment of surviving, except the food (such as books). Outside, the warm humidity is also a key factor. Exceed 25°C as temperature, most insect can grow and multiply fast, look on as temperature lie between at 15°C - 20°C, will slow down the pace bred; It will influence insect's development <sup>[45]</sup> at 10°C that it is low. As for insect's demand for the humidity, will be different to some extent with kind of the insect, some insects need high humidity environment (Clothing fish), but some insects can obtain the necessary moisture from the food directly (Wooden termite of the universe). Learnt by the literature, relative humidity 60%- 80% are suitable for insect's reproduction. As temperature is higher than 25°C, the relative humidity is greater than 70%, as to most insects, will breed and grow fast; As regards humidity, the demand for each kind of insect is not the same. But whole but speech, reduce humidity can reduce <sup>[45]</sup> probability that insect pest take place.

Therefore can know, the basic principle is low temperature, low humidity to prevent the insect from being of endangering the books and file. But stand in the books keeping, general people and on staff member's position in the hall, besides considering keeping security, should give consideration to personnel's comfortableness. So temperature and the two of humidity can't be too low. The books file is kept the comfortable degree of security and personnel should make the equilibrium. Generally propose temperature is set up at 21±1°C, the humidity must accord with property and state of the paper material, and give and adjust (metal historical relic appropriately: Under 45%; Organic material historical relic: 50% - 60%). Should moreover prevent from warmly, the humidity changes by a wide margin, some phenomenon not even of preventing the occurrence of warm, humidity, and use to reduce the situation of damaging books file and take place. Because some humidity apt to multiply microorganism or mould too high, attract edible insect of mould, for example clothing fish, book louse, etc. enter the paper books file and store the place, gnaw the books or file <sup>[46]</sup>.

The fleas are a complete metamorphosis insect, have ovum, larva and pupa and adult are four growth periods. Begin to lay eggs in 1-4 days behind the female flea sucks the blood, the ovum is produced in host's nest (in the nest) and in the nearby floor chink; some fleas can lay eggs in host's hair. The flea ovum development relates to temperature, humidity and adult, a nutritional status, suitable for the temperature of laying egg is above 70% for 18°C - 27°C, humidity; 35°C - 38°C high temperature will inhibit flea's ovum development, will also limit the flea ovum development <sup>[47]</sup> to pass low temperature seemly.

According to the literature, *Dermatophagoides pteronyssinus* like life to make warm (20°C-30°C), (Relative humidity 60%- 80%) in dark environment. Mankind feel comfortable environment (Temperature 25°C, relative humidity 75%). Similarly, it is the *Dermatophagoides pteronyssinus* optimum condition of existence too. Regard locating in

subtropical Taiwan as example, will it be will it be the beginning and winter autumn late summer for irritation, asthma kind to take place season. Is the literature pointed out, the dust in the environment? The main reason<sup>[48]</sup> it is the good hair. Does another research point out the dust? With the mankind or animal (cat and dog), scurf, hair coming off support the family; Suitable for temperature of growth its 22°C-26°C, relative humidity 70%- 80%. And about 15°C-30°C of average temperature in Taiwan room, about 60%-85% of relative humidity on average, so, does the climate environment of Taiwan benefit the Dermatophagoides pteronyssinus growth. Cause the dust? Become one of Taiwanese children's important anaphylactogens<sup>[49]</sup>. This phenomenon can be verified with the detection data that the municipal health bureau of Taipei will release in 2008. Measure and point out in the data: Do the first grade primary school pupils' anaphylactogens mostly come from "Dermatophagoides pteronyssinus" account for 90.8%<sup>[50]</sup>.

#### 4 Suitable for the warm humidity of the life of human house

Learn, most suitable for the temperature that the mankind lives with relevant literature is 22°C-26°C. The mankind lives or lives think the most comfortable temperature is 24±2°C in other words. Taiwan is located in the subtropical zone, the average temperature of winter: 15°C-25°C, the average temperature of summer: 25°C-38°C. If look over simply. Taiwan should belong to the country suitable for living with the temperature view. However, Taiwan is surrounded by sea on four sides, belongs to the island type climate, the humidity is originally a bit high. In addition, Taiwan is close to the Pacific Ocean, the location is in monsoon to take; because plum rains, Northeastern monsoon or typhoon of every year, is that Taiwan brings the plentiful rainfall. In addition, the convective rain of Taiwan is vigorous, lead to the fact the humidity of Taiwan remains high, except that movable property or real estate is apt to be decreased by moisture corrosion and water, temperature is suitable for the climate environment a bit high in humidity, become microorganism, bacterium, mould, insect grow hotbed multiplied also, cause the epidemic situation of plant diseases and insect pests to increase<sup>[51]</sup>.

The indoor relative humidity of the building is too high or too low, all exert an unfavorable influence as to living at home. Is the humidity too high, apt to be stale and causing the Dermatophagoides pteronyssinus. No matter the Dermatophagoides pteronyssinus, the Dermatophagoides pteronyssinus excrement, Dermatophagoides pteronyssinus body, the corpse will all become children's anaphylactogen; However, too low for humidity, to people, it is astringent to be apt to cause skin chap, eyes or the universe of nose mucous membrane, easy to be rubbed the static that is produced to shock by electricity. Point out in the literature: The relative humidity of the most suitable life of human house: 45%- 55% RH. Want, let people feel comfortable, can't consider relative humidity take suitable temperature collocate even only. Because the higher temperature is, the more air vapor is. So is the higher for temperature, the relative humidity does not let people feel comfortable until being the lower; Come oppositely to say, the lower temperature is, the higher soon the relative humidity will be. But the too high or pass and low humidity is not good to the health. When the temperature is 35°C, the relative humidity 35% RH will be more comfortable; Centigrade of temperature is at 30°C, the relative humidity 45% RH will be more comfortable; The temperature is at 25°C, the relative humidity 55% RH will be more comfortable. The house humidity relates to human comfortableness, physiology, hygiene and health. Degree is while rising, the human



body releases too much heat with the perspiration. Look on as the environmental relative humidity, the human body is unable with the release heat of the perspiration, will feel uncomfortable. Besides perspiration, the human body can evaporate the internal moisture with skin and respiratory system, use to regulate the body <sup>[51]</sup>. Influence the skin to evaporate the moisture factor, also relate to environmental relative humidity of the house besides cortex surface state <sup>[52, 53]</sup>. Temperature and humidity of the climate environment, reciprocation and then the human physiology of influence or quantization indicator of the psychology, in 1959, Thom E. C. <sup>[54]</sup> Propose: Uncomfortable index Discomfort Index (DI) Concept. Point out and act as (DI) while studying Will feel slightly hot that up to 75- 80, will feel hot and will sweat at 80- 85 will feel hot driving people up a wall when the 85 more than.

Will moreover influence study state and working efficiency of “learner” or “staff members” in the building room respectively when the warm humidity changes. The research results are pointed out <sup>[55]</sup>: When improving the temperature of indoor air conditioner, can be by method to reduce humidity, to promote indoor personnel's satisfaction. Secondly appropriate to reduce indoor ambient temperature, can raise psychology satisfied reaction and working efficiency. Moreover examined personnel but the speech to studying, under different indoor environmental conditions of warm-heat evil, match 40% of humidity and temperature and 22.0°C and match 60% of humidity with 22.0°C of temperature, the warm damp condition in two kinds of rooms, benefit for improving ' working efficiency ' to some extent. And reflect and investigate the result of study and learn, the environmental condition of the best warm humidity is 22.0°C of temperature in the room according to the psychology, 60% of humidity.

In addition, can still be learnt by this research results, in the same humidity (40%) Under the condition, (28°C > 22.0°C) when the ambient temperature is the higher, One's own satisfaction to the job will be thereupon reduced. Temperature is 22.0 °C and 40% and 60% of humidity, for environmental conditions of better warm-heat evil of promoting “working efficiency”. At the same temperature (22.0°C), 40% of humidity and humidity and 60% of the two, the influence on working efficiency has not been showing the difference.

## RESEARCH APPROACH

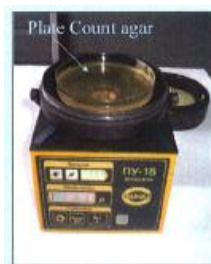
The place of the angry glue of living beings is collected in this research, is one public library in the peach garden county. The experiment measures the reason why the target chooses this particular use of the library, explain and show as follows:

1. The environmental protection administration of executive organ surrounded the indoor air quality proposing value of the letter announcement No. 0940106804 of administration's empty word according to December 30, the 94th year of the Republic of China, the fourth place of “the 1st kind” of item 1, include: “school and educational place, children travel the place, medical place, old man or disability look after the place”. But has not enumerated this kind of place of the “the library”. In order to find out about the library indoor air quality of place of this particular use. This research chooses library as the research object.
2. Except the library can meet general people's curiosity, increase knowledge and substantiate and can study from my essence, the library has already become a part of people's daily life, the wide place that has been liked by nearby residents and often called on now. Worth studying, the contribution degree is high.
3. The library is based on its particular function demand, except that the scale of the

building, set up the position and because in conformity with local government's special requirement, and slightly outside the difference, the planning, design, space of every place dispose and use properties in the library hall, very much the same. After selecting the representative target, its applicability of result of study is relatively wide.

Originally study the department and use “the impacted taking a sample device” (Buck, Bio-Culture B30120), Smoke the air sample breathing in right amount of volume, and assault the sample on the culture medium suitable for fungus growth directly. Train it in the course, train the ambient temperature:  $30 \pm 1^\circ\text{C}$  train time:  $48 \pm 2$ hrs, culture medium take a sample medium as TSA (Tryptone Soy Agar) ,Its main component is agar (Tryptone, Soy peptone Nacl, Agar) ; The flow of the taking a sample device: 100L/min; The time of taking a sample: 1min; Take a sample in month: February and April; Take a sample in period: 09:00,12:00, It amounts to three periods of period at 15:00; Take a sample and click the density: Big or small in area according to the floor of floor and determines, every 500- 1,000m<sup>2</sup> sets up one is gathered and clicked. Relevant experimental facilities and step show as below:

1. The impacted taking a sample device, as show in fig 1.



*Traditional Plate Counts*



*Bioluminescent ATP-assay*



*The Sieve Air Sampler*

*with High Flow Rate*

Figure 1 The impacted taking a sample device, source of the photo [15]: Bioluminescent ATP-assay

2. Experiment step: Plate Count Agar (air sampling) ,Culture medium cultivates the microorganism (Such as fungi), Incubation (48hr) ,calculate the microorganism (Such as the fungi or bacterium), enumeration( CFU/m<sup>3</sup>) .
3. The colony is counted: Train the microbial quantity of the ware, fetch log<sub>10</sub>, count (CFU) for the colony ( Colony forming units) .
4. Colony thickness: And then change into the microbial colony thickness (CFU/m<sup>3</sup>) via calculating.

## RESULT OF STUDY

This research object is one public library in the peach garden county, it was according to period that this library was created in 1923, lie in the special zone of county government of garden of peach, carry on it in the experiment course of microbial colony thickness, must obtain management unit agree, try hard, lower people to be inconvenient outside. Should consider representativeness and integrality of taking a sample. In other words, besides should overcome the human factoring, the necessities and importance of some quantity, etc. that must consider taking a sample in the floor scrupulously, take a sample in the field and take a sample. After considering all subjective and objective influence factors, determine to carry on the date of taking a sample finally: February 24 and April 7; Take a sample in the floor: The

1st floor, the 4th floor and the 5th floor; The place of taking a sample: 7 piece place (Information department, periodical room, reading room for children, seeing and hearing classroom, open-shelf reading room, last room and reading rooms ordinary) ,The samples are lighted 84 altogether.

### **1. enter the total number of person of the hall and colony thickness are related**

Learnt by the experiment materials, it is 467 to enter the total number of person of the hall on February 24, the thickness average of the colony is 104 (CFU/m<sup>3</sup>) on the same day, It is 374 to enter the total number of person of the hall on April 7, 2010, the thickness average of the colony is 211 (CFU/m<sup>3</sup>) on the same day ,If according to general people's cognition, always thought activity the total number of person was the more in the library, it is the greater to present the angry glue probability of living beings, the colony thickness of April 7 the same day should be higher than February 24. But experimental result happens that the opposite answer appears. If regard thickness average of the colony as the parameter of depending on, count the scale in order to probe into the factor with people, utilize SPSS to learn, personnel count with the thickness average of the colony after counting the software and carrying on LSD multiple comparative analysis, have not been showing the relation ( $p > 0.05$ ) . In addition, even when being the same in case of the same use (area), Adopt user's density (People/m<sup>2</sup>) when the view probes into the colony thickness, it is also unable to demonstrate and show the relation ( $p > 0.05$ ). The research results that experimental result and literature of this research describe: ' the total number of the colony in the indoor air is influenced by a lot of factors, such as personnel's density of the room ' <sup>[13]</sup>, not all the same.

In fact, no matter any place, propose pondering over the looks corresponding relation of “personnel's quantity” and the two of “colony thickness” from the following two views. First, the angry glue of living beings of outside is the larger in quantity on the spot, and personnel enter internal number of people in the place from outside the more, the probability of internal colony thickness rising of this place thereupon increases. Second, if does not consider the angry glue quantity of living beings of outside of building first, has already had angry glue of living beings as entering the internal personnel in the place, then living beings angry glue quantity in the place, will with enter place personnel increase and increase. In other words, indoor colony thickness, besides relating to outdoor colony thickness, also relate to personal sanitary condition. Suppose the outdoor surrounding air is best in quality, and personnel's hygiene state is good, even more personnel enter the library, the indoor colony thickness will not show the change because of increasing in number of people.

### **2. Relation between height of the floor and time of taking a sample and colony thickness**

Besides special circumstances, general people could reach the other floors through the 1st floor. So is being the same in environmental cases outside, the first floor is people's only way which must be passed, judged the first floor presents the angry glue probability of living beings and higher than the other floors by the convention. But can learn after carrying on LSD multiple comparative analysis according to the experimental result of this research and with SPSS software, there is no direct corresponding relation ( $p > 0.05$ ) in colony thickness and height of floor. Secondly, the angry glue of living beings can be direct or indirect, can be with the morning or in the evening, any time point is entered and stayed in the library. So the

colony thickness, will not show the difference ( $p > 0.05$ ) because of time is different to take a sampling in the library.

### **3. Relation between the area of floor of floor and colony thickness**

This research is in 7 places separately (information department, periodical room, reading room for children, seeing and hearing classroom, open-shelf reading room, last room and reading rooms ordinary) carry on the angry glue of living beings and take a sample, and learn after carrying on LSD multiple comparative analysis with SPSS software, the higher it does not represent colony thickness that the larger the area of floor of floor is. The area size of floor of floor and thickness average of colony, it is being related ( $p > 0.05$ ) that the two have not been showing. This situation can prove by aforesaid living beings angry glue sampling method <sup>[13]</sup>. Literature point out “small living beings angry glue among air, easy to bully, flow, influence more unstable, so unable to control the angry glue of living beings effectively down”. So can learn, the angry glue of living beings fluctuates with the air current, fall in each corner in training wares or ground at random. Generally speaking, receive will to the angry glue probability of living beings the higher when the area is the larger, but there is no absolute relation. For example, as the building opened the muzzle to just face the outdoor high pollution sources, or the personnel who it happened that enter this place are all carriers. Under this situation even the area of place is relatively small; its thickness of colony will also be higher than the floor of building in the place larger in area.

### **4. The place uses the relation between properties and the colony thickness**

Can learn, the top three supreme in thickness of the colony are in the library in order after being analyzed by the experimental result and SPSS software: “periodical room”, “the reading room for children” and “open-shelf reading room”; Lowest in thickness with the colony among them, as shown in Table 3.

Regarding thickness average of the colony, consult the room and show the difference nature ( $p < 0.05$ ) with the periodical room, reading room for children and open-shelf reading room separately, As shown in Table 4. To this phenomenon, the administrative staff of the library, should check the place that indoor air quality is worse, whether because the air conditioning causes efficiency to be relatively bad too old; Because to furnish too the crowdedness and space are overly closed, result in ventilating badly. By investigating live that learns, “consult the room” the foreign window has not been furnished the direction parallel to window by the indoor art work or stopping, indoor bookshelf of book case, ventilate and the day lighting state is good, and consult the room and has not offered the desk chair for the persons who read to use, comparatively speaking the time that personnel stay in this place is relatively short.

Table 3 Average number value of the angry glue of living beings of all kinds of places

Describing statistic: Thickness average of the colony							
	Average	Standard deviation	standard misses	average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
Information room	101.0000	70.66824	28.85019	26.8382	175.1618	33.00	193.00
Reading room for children	208.3333	63.06082	25.74447	142.1551	274.5116	100.00	280.00
Consult room	70.0000	61.64414	25.16611	5.3084	134.6916	5.00	175.00
Periodical room	215.0000	148.35768	60.56677	59.3082	370.6918	95.00	475.00
Open-shelf reading room	202.5000	159.86713	65.26548	34.7297	370.2703	55.00	510.00
Look and listening room	183.3333	155.77762	63.59595	19.8547	346.8119	20.00	440.00
Ordinary reading room	122.5000	48.86205	19.94785	71.2224	173.7776	85.00	210.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 4 consults the difference between the room and colony thickness of other types place

place (I)	place (J)	Average difference (I-J)	standard misses	Dominance	95% trust range	
					Low bound	Upper bound
Consult room	Information room	-31.00000	64.36219	.633	-161.6622	99.6622
	Reading room for children	-138.33333*	64.36219	.039	-268.9955	-7.6711
	Periodical room	-145.00000*	64.36219	.031	-275.6622	-14.3378
	Open-shelf reading room	-132.50000*	64.36219	.047	-263.1622	-1.8378
	Look and listening room	-113.33333	64.36219	.087	-243.9955	17.3289
	Ordinary reading room	-52.50000	64.36219	.420	-183.1622	78.1622

\* The average difference is apparent at 0.05 levels

## 5. Relation between temperature or humidity and colony thickness

This research takes a sample in the angry glue of living beings in the course, warm humidity ranges in the room are: Temperature: 20.2°C-25°C; Humidity: 49.2%- 69.0%. Analyze that learns according to the experimental result and SPSS software, as shown in Table 5. Act as temperature range in order: Small at 22.1°C, is between 22.1°C and 23.7°C and big at 23.7°C, the averages of the colony thickness are: 106.3 CFU/m<sup>3</sup>, 154.2 CFU/m<sup>3</sup> and 205.2 CFU/m<sup>3</sup>. Moreover this research is with February 24 diurnal average temperature, average humidity (22.1°C, 64.6%) separately And 7 diurnal average temperature, average humidity (23.7°C, 56.1%) in April, Click in the sector that counts the software and analyzes as SPSS, as Table 5 and Table 6 shows. Can be learnt by Table 6, when the block of temperature is between 20.2°C and 25°C, temperature small colony thickness and large colony thickness at 23.7°C of temperature at 22.1°C, the two have apparent difference nature (p<0.05). And is learnt by the statistical data, the big colony thickness at 23.7°C of temperature exceeds the small colony thickness at 22.1°C of temperature. The colony thickness relates to temperature. Rise with temperature colony thickness have trend of increase.

Can be learnt by Table 7, when humidity range is between 49.2% and 69.0%, the humidity is smaller than 56.1% of the colony thickness and humidity and lie between the colony thickness of 56.1% and 64.6%, the two show the difference nature ( $P < 0.05$ ). And the humidity is smaller than 56.1% of the colony thickness and humidity and greater than 64.6% of the colony thickness, the two also show the difference nature ( $P < 0.05$ ). And is learnt by the statistical data, the humidity is smaller than 56.1% of the colony thickness and exceed the humidity and is greater than 64.6% of the colony thickness. If regard colony thickness as the parameter of depending on again, and regard humidity as the independent variable, analyze that learn, humidity and the two of colony thickness have dominance ( $P < 0.05$ ), As Table 8, Table 9 and Table 10 shows. Can learn lie between 49.2% and 69.0% by range as humidity, humidity high colony thickness little while being described above. Return to equation preface to show as follows:

$$y = -0.438x \text{ ----- (1)}$$

However, while considering the two of temperature and humidity influence the colony thickness at the same time, it is unable to show the relation ( $P > 0.05$ ), As Table 11 and Table 12 shows. Stated, perfectly in harmony or agreement without previous consultation this phenomenon and literature [20]. Whole but the speech, influences the influence factor of colony thickness of the library to use properties by indoor humidity, indoor temperature and field.

Table 5 different temperature situations make the average of the colony thickness

Describing statistic: Thickness average of the colony							
Temperature range	Average Standard	deviation	standard misses	Average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
< 22.1°C	106.3333	78.63417	22.69973	56.3716	156.2951	20.00	280.00
22.1°C ~ 23.7°C	154.1875	117.01807	29.25452	91.8330	216.5420	5.00	475.00
> 23.7°C	205.2143	130.68410	34.92680	129.7595	280.6690	45.00	510.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 6 dominance of different temperature of thickness average of colony

Temperature range (I)	Temperature range (J)	Average difference (I-J)	standard misses	Dominance	Average 95% trust range	
					Low bound	Upper bound
< 22.1°C	22.1°C ~ 23.7°C	-47.85417	43.04164	.273	-134.9141	39.2058
	> 23.7°C	-98.88095*	44.33966	.032	-188.5664	-9.1955
22.1°C ~ 23.7°C	< 22.1°C	47.85417	43.04164	.273	-39.2058	134.9141
	> 23.7°C	-51.02679	41.24744	.223	-134.4576	32.4040
> 23.7°C	< 22.1°C	98.88095*	44.33966	.032	9.1955	188.5664
	22.1°C ~ 23.7°C	51.02679	41.24744	.223	-32.4040	134.4576

\* The average difference is apparent at 0.05 levels

Table 7 different humidity situations make the average of the colony thickness

Describing statistic: Thickness average of the colony							
Humidity range	Average	Standard deviation	standard misses	Average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
< 56.1%	245.8000	132.05538	41.75958	151.3333	340.2667	110.00	510.00
56.1% ~ 64.6%	139.7500	106.47751	23.80910	89.9170	189.5830	5.00	475.00
> 64.6%	113.5833	84.81258	24.48328	59.6960	167.4707	20.00	270.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 8 dominance of different humidity of thickness average of colony

Humidity (I)	Humidity (J)	Average difference (I-J)	standard misses	Dominance	Average 95% trust range	
					Low bound	Upper bound
< 56.1%	56.1% ~ 64.6%	106.05000*	41.67107	.015	21.7623	190.3377
	> 64.6%	132.21667*	46.06910	.007	39.0331	225.4002
56.1% ~ 64.6%	< 56.1%	-106.05000*	41.67107	.015	-190.3377	-21.7623
	64.6%	26.16667	39.28786	.509	-53.3005	105.6339
> 64.6%	< 56.1%	-132.21667*	46.06910	.007	-225.4002	-39.0331
	56.1% ~ 64.6%	-26.16667	39.28786	.509	-105.6339	53.3005

\* The average difference is apparent at 0.05 levels

Table 9 colony thickness and humidity on average regression equation  $R^2$

model	R	$R^2$	estimate after $R^2$	adjusted standard misses	changing amount				
					$R^2$ changing amount	F change	df <sub>1</sub>	df <sub>2</sub>	dominant F to change
1	.438 <sub>a</sub>	.192	.172	106.25619	.192	9.502	1	40	.004

a. Predict parameters: (constant), Average humidity

Table 10 dominance regression equation between colony thickness and average humidity

Coefficient <sup>a</sup>						
model		Not standardized coefficient		Standardized coefficient	t	dominance
		B estimated value	standard error	Beta distributed		
1	(constant)	726.835	185.414		3.920	.000
	Average humidity	-9.432	3.060	-.438	-3.083	.004

a. Depend parameters: Thickness average of the colony

\* The average difference is apparent at 0.05 levels

Table 11 R<sup>2</sup> of temperature and humidity interaction between colony thickness average

model	R	R <sup>2</sup>	R <sup>2</sup> is adjusted alters statistic by mistake	Estimate standard misses	changing amount					
					R <sup>2</sup> changing amount	F changes	df <sub>1</sub>	df <sub>2</sub>	dominant of F change	
1	.314 <sup>a</sup>	.099	.076	112.21624	.099	4.383	1	40	.043	
2	.451 <sup>b</sup>	.204	.163	106.82815	.105	5.137	1	39	.029	
3	.457 <sup>c</sup>	.209	.146	107.86517	.005	.254	1	38	.617	
a. Predict parameters: (constant), Average temperature				b. Predict parameters: (constant), Average temperature, average humidity			c. Predict parameters: (constant), Average temperature, average humidity, temperature multiplies humidity			

Table 12 dominant of temperature and humidity interaction between colony thickness averages

model		Not Standardized coefficient		Standardized coefficient	t	dominant	synteny statistic	
		estimated value of B	standard error	Beta distributes			and permits difference	VIF
1	(constant)	-472.942	301.625		-1.568	.125		
	Average temperature	27.534	13.151	.314	2.094	.043	1.000	1.000
2	(constant)	1361.262	858.722		1.585	.121		
	Average temperature	-17.883	23.629	-.204	-.757	.454	.281	3.562
	Average humidity	-13.159	5.806	-.611	-2.266	.029	.281	3.562
3	(constant)	1146.503	966.218		1.187	.243		
	Average temperature	-12.787	25.914	-.146	-.493	.625	.238	4.203
	Average humidity	-11.690	6.548	-.543	-1.785	.082	.225	4.444
	temperature multiplies humidity	-11.349	22.532	-.081	-.504	.617	.802	1.248
a. Depend parameters: Thickness average of the colony								

## CONCLUSION AND SUGGESTION

This research is to regard one public library in the peach garden county as the research object, utilize the assaulting device (Bioluminescent ATP-assay) With the software of statistical analysis (SPSS) Wait for tools, the ones that probe into various factors and colony thickness of library are related. Can learn, the colony thickness of every place of this library is all smaller than 500 CFU/m<sup>3</sup> according to the result of study, accord with suggestion value of 1st kind of environmental protection administration. Moreover according to the statistical analysis data, can learn the indoor colony thickness and enter factors such as the total number of person, height of the floor, sampled time, area of floor of the library, etc., it is not related. Colony thickness and ambient air quality of the building in the library, passing in and out the





personal sanitary condition of the people and staff member to have something to do with, influence the main factor of the colony thickness of the library, include: Indoor humidity, indoor temperature and use property.

To place of this particular use of the library, should be by “the safe save of the books file in the library”, “use the people's health with comfortableness” in order to consider the direction. To two aforesaid general orientations, its situation influencing the factor to be numerous and the interaction often take place, pinning down each other. As for safe save of the books file, testing it factor, including mould, fungi, bacterium and radiating fungus causing “mould and rotten”, “change color” or “go bad”, etc. question; Secondly it is clothing fish, book louse and wooden termite of the universe, etc. that regard paper books as the insect of the food, unprincipled to gnaw questions such as the books, etc.. Finally: Whether the warm humidity will cause questions such as the brittle rupture of the paper and making moist, etc. Separately as for the people's health and comfortableness: Except that comfortableness involves the personal adaptive capacity and psychology and experiences subjectively, microorganism and small particle, fleas, dust coming out by little organism release in the air. When all relating to the fact that the people are healthy. Want, give consideration to “books safe save of file” and “health and comfortableness of people” at the same time, and often make the administrator in a dilemma, in a dilemma. Study, learn, can set up appropriate mechanism of management, room temperature and humidity of internal environment control properly, can easily solved up to the result getting twice the result with half the affording aforesaid important problem.

Learn after this research reviews with statistical analysis with the literature, colony thickness, mould (or the bacterium) Survive with breeding, so as to the mould (or the bacterium). It is insect of the food, paper books file that are made moist brittle rupture, personnel in indoor psychology reacting and working efficiency, etc., all relate to warm humidity environment in the library room. The warm humidity is a key factor of influencing every factor described above. The colony thickness presents the trend increased when rising in ambient temperature, look on as the environmental humidity the higher the colony is the lower in thickness. However, if the one that consider the warm humidity to colony thickness at the same time is related, do not have dominance ( $p > 0.05$ ) . Learnt by this result of study, the best temperature range of library is 20°C - 26°C , and the range of relative humidity is 40%- 60% RH.

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