Cálculo del riesgo de incendio en interior de farmacias comunitarias y extinción. Método de Gustav Purt

Bernardo Prieto Muñoz

Departamento Farmacia y Tecnología Farmacéutica. Universidad Valencia, Valencia, España.

Enviado: 9 de enero, 2022
Aceptado 22 de noviembre, 2022

Contacto de correspondencia: Bernardo Prieto Muñoz. e-mail: bjprietom@gmail.com

RESUMEN

El fuego es una reacción química de combustión, basado en los fenómenos de oxidación-la reducción fuertemente exotérmica que se manifiesta por desprender gran cantidad de luz y calor. Sus efectos son generalmente perjudiciales, produciendo daños personales por el humo, gases tóxicos y temperaturas extremas, causando grandes daños a instalaciones y bienes. El fuego se produce cuándo existen simultáneamente en el tiempo y en un mismo lugar los tres factores siguientes: combustible, agente comburente, normalmente el oxígeno del aire y calor, que contribuye con la energía necesaria para activar la reacción. Además, es necesario, para la producción de la llama, la existencia de reacciones de cadena. El objetivo de este trabajo es describir el método Gustav Purt y estimar el riesgo potencial de incendios en farmacias así como describir qué medios de lucha contra incendios son necesarios implementar. Tras el cálculo de los distintos factores, se llega a la conclusión que el riesgo de incendio en una farmacia es elevado. Por consiguiente, es necesario la estricta inspección de las autoridades sanitarias de la Administración para evitar el peligro del fuego.

Palabras clave: Combustible; Fuego; Calor; Humo; Farmacia.

Calculation of fire risk and firefighting inside community pharmacies. Gustav Purt's method

ABSTRACT

Fire is a chemical combustion reaction based on strongly exothermic oxidation-reduction phenomena that result in the emission of a significant amount of light and heat. Its effects are generally detrimental, causing harm to individuals through smoke inhalation, exposure to toxic gases, and extreme temperatures. Fires also cause extensive damage to infrastructure and property. A fire occurs when three factors are present simultaneously in the same location and at the same time: fuel, an oxidizing agent (typically oxygen from the air), and heat, which supplies the necessary energy for the reaction to occur. Furthermore, the existence of chain reactions is essential to produce the flame. The objective of this work is to describe Gustav Purt's method, estimate the potential fire risk in community pharmacies, and identify the firefighting measures that should be implemented. After calculating various factors, we reached the conclusion that fire risk in a pharmacy is high. Therefore, strict inspections by health authorities are necessary to prevent fire hazards.

Keywords: Fuel; Fire; Heat; Smoke; Pharmacy.

INTRODUCTION

All Technicians in prevention have to know the basic principles of the detection and prevention of fires, the constructive passive measures of the buildings, the conditions of evacuation of the job centers and the general behavior in case of an accident. All this constitutes a social duty of first magnitude, more important in an open sanitary establishment to the public as it is the community pharmacy.

The fire originates by the incidence of a source of heat that goes in contact with the fuel and initiates the emanation of the gasses, which inflame when the temperature of inflammation is achieved. With this inflammation, a contribution of calories to the environment is originated, adding them to the already existent heat pertinent of the first source of heat (1).

To understand the process of the fire is necessary to define "energy of activation", that is the mínimum necessary energy that initiates the reaction. It depends on the type of fuel and the conditions in which it is found (pressure, temperature, …). The energy of activation is provided by the "ignition sources", these can be electrical (warming by resistance, warming by induction, static loads, etc.), mechanical (heat of compression), thermal (sparks of combustion, hot surfaces) and chemical (heat of solutions, heat of decomposition). All, or almost all, these focuses give or can give in a community pharmacy.

The combustion is represented by a triangle, in which each one of the sides corresponds to the fuel, comburent agent (oxygen) and energy of activation (heat). If any of these elements is not present, the combustion does not produce (2).

Some metals do not need the oxygen for his oxidation, it is the case of the sodium and the potassium (they can be present in the laboratories of master formulas of the community pharmacies), that can to oxidation when going in in contact with the water without mediating the atmospheric air.

This has brought, as a consequence, that nowadays is compared to the phenomenon of the fire with a tetrahedron of the fire, when entering a new element: the chain reaction (3).

Chain reaction is the set of correlated events in the time that define a fire. They follow these stages: ignición, propagation and consequences.

1.- Ignition: It is produced when a fuel, in determinate conditions, goes in contact with the air and receives the energy of activation supplied by a focus of ignition.

2.- Propagation: it is the evolution of the fire in the space and time.

3.- Consequences: they are the harms to sake and injuries to derivative people of the fire and his propagation. The fatal consequences for the people are generally caused by the impossibility of evacuation and the desorientation of them by fault of vision, due to the smokes and gases and temperature of combustion intoxications, asphyxias and burns (4).

Method of Gustav Purt.

The evaluation of the objective risks is one of the pillars of the technicians of prevention. The method of evaluation of the risk of fire that presents is one of the most used among the specialists in the subject for the evaluation of average risks.This method of evaluation was presented by the Dr. Gustav Purt in the sixth International Seminar of Automatic Detection of Fires.

It explains essentially preventive measures that have the purpose of the following points: First, achieve that the probability of declaring a fire is very small. Second, in case a fire is produced, it must not be able to extend quickly and freely, meaning it must only cause the minimal possible damage (5).

The destroyer action of the fire develops in two distinct fields, the edifices and his content. The risk of the edifice is in the possibility that it produces an important harm: the destruction of the real estate. It depends essentially, of the opposite action of two factors, the intensity and length of the fire, and the resistance of the construction.

The risk of the content is constituted by the harm to the workers and material sakes in the interior of the edifice.

The two risks are joined one to the other so, the destruction of the edifice spends achieve also, generally, the destruction of his content whereas, inversely, the thermal load released by his content represents, very frequently, the main danger for the edifice (6).

MATERIALS AND METHOD

Calculation of the risk contained (IR)

It is going to proceed only to the calculation of the risk of the content because for all the pharmacies it is homogeneous. The calculation of the risk of the edifice, to my understanding, is not necessary in a job like this because it is influenced by the year of construction of the edifice, material, etc.

In case of fire in the pharmacy, a clear danger for the workers as for the users of the pharmacy exists. Regarding the users, they can be pensioners. It is necessary to say that the main people are used to to be polymedicated patients and therefore, they attend to the pharmacy frequently and his stay in it is used to to prolong during quite a lot of time.

Except for people with some disability, a healthy person in a pharmacy in case that a fire is produced, would achieve easily the public road since the patients can not spend to the interior of the pharmacy, having to remain imperatively, in the part of attention to the public, that is to say, the most next to the door that gives to the public road.

It exists a danger for the sakes (in this case medicines and sanitary products), because they present a big sanitary value. In a pharmacy there are sakes of tall value and the medicines deposited are important to cure illnesses, they are not irreplaceables but they deteriorate in contact with the products of extinction.

The smoke increases, even more, the danger for the workers of the pharmacy. The smoke prevents the vision and the breath, this gives place to dizziness and faintings.

The studio of these three factors of influence gives us the following formula:

IR= H. D. F

H = Danger for people coefficient.

D = Danger for the vulnerability to the destruction coefficient

F = Influence of the smoke coefficient.

RESULTS

Calculation of the different factors

H = Danger for people coefficient.

Table Nº 1: VALUES OF THE COEFFICIENT H OF DANGER FOR THE PEOPLE.

SCALE	DEGREE OF DANGER	H
1	There is no danger for people	1
2	There is danger for people, but are not made disabled	2
3	People in danger because they are disabled	3

The following table shows the numerical values attributed.
In the case of a pharmacy office, in my opinion, corresponds him a value of H of 2 (in case of people with functional diversity the value would be 3), yes there is danger for the people but these can save in case same.

D = Factor of danger for the vulnerability to the destruction.

Table Nº 2: VALUES OF THE COEFFICIENT D CORRESPONDING TO THE VULNERABILITY TO THE DESTRUCTION.

SCALE	DEGREE OF DANGER	D
1	The content of the edifice does not represent an important value	1
2	The content of the edifice represents an important value	2
3	The disappearance of the content is definite	3

The table indicates the classification.
In the case of office of pharmacy, to my understand, corresponds him a value of D of 2, the content yes that supposes a considerable value.

F = Corresponding factor to the action of the smoke.

Table Nº 3: VALUES OF THE COEFFICIENT F FOR THE SMOKE.

SCALE	DATA	F
1	Without danger of smoke	1
2	More of the 20% of the materials release smokes	2
3	More of the 50% of the materials release smokes	3

The value that corresponds to F in a pharmacy is 3, more than 50% of the weight of the material fuels are material that release a lot of smoke and besides are toxic.
In a pharmacy office applying the anterior formula would exit an index of risk of the content of

I.R. = 2x2x3 =12;
In case that the users of the office of pharmacy are disabled people or with mobility reduced the calculation would be

I.R. = 3x2x3 = 18

A upper risk to 10 is high (7).

DISCUSSION

Technicians of Prevention against fires in the community pharmacy.
Once analysed the different factors that take part in a fire (fuel, comburent agent, energy of activation and chain reaction) and the need that they present of conjoint form to produce the fire, for averting his start and his consequences, we will have to act in the first place in the phase of design of a community pharmacy.
They have to foresee installations of extraction and suitable ventilation in the laboratory where carry out master formulas. Also, the location has to be studied, to be safe, services like electrical installation and stoves and his corresponding protection elements.
Measures on fuel.
- Storage and conservation, Heat power of the products stored and fixation of maximun volumes have to be taking into account, an example, is the accumulation of big quantities of ethanol in a pharmacy.
Signage of security.
- Substitution, if possible, of a fuel by another that have an upper flashpoint.
- Ventilation of these zones.

- Refrigeration of the zones with fuel, to decrease the temperature les than the flashpoint.
- Delete the flammable waste and utilisation of hermetical containers.
- Aspire those zones where can generate flammable mixes.

Measures on the comburent agent.
- Reduce the proportion of oxygen, by means of the utilisation of inert gases like carbon dioxide or nitrogen.
- Use tight containers.

Measures on the energy of activation.
-Preventive maintenance of the installations and electrical devices.
-Refrigerate or ventilate the exposed venues to thermal loads of the environment.

Measures on the chain reaction.
-Addition of antioxidants in plastics.
It is understanding as protection against fires, the set of tending measures to mitigate the negative effects produced by the fire. These measures can be summed in two concrete actions:
- Detect and alarm.
- Extinguish

Means of detection and alarm.
It is understanding as detection the discovery of the existence of a fire inevitably after it have initiated.
The detection of the focus of fire is fundamental to avert the propagation of the fire. Generally the fires arise accompanied of the following manifestations: gases, smokes, llamas and heat. The systems of detection of fires are based in them.
The fast detection of a fire has to go with a correct location of it, if this is not achieve, the detection system would be ineffective.

Automatic detectors.
They are sensitive devices to variations of environment, that register, compare and measure automatically the phenomena or the variations that announce the apparition of a fire (smokes, gases, heat, llamas, etc.). They transmite this signal to a head office.
These detectors can be;
- Gases or ionic detectors.
- Visible smokes detectors.
- Fixed temperature detectors.
- Llama detectors.

In ancient pharmacy offices any of these detectors is found, however in new opening pharmacies and also, pharmacies with big surface for the attention to the public, the exhibitors are a necessary investment in the design of the pharmacy.
Detectors of combustión gases, are the more used in pharmacies, trades and big surfaces, to detect the visible and invisible smokes produced in a fire. They are based in the absorption of the light by the smokes.

Detectors of temperature: they can be of two types:
- the thermostatic detectors signal the apparition of a fire when it exceeds a fixed temperature in advance.
- The thermovelocimetric detectors signal the apparition of a fire, when the growth of temperature by unit of time exceeds a determinate value, usually 10ºC/minute.
The detection installation and alarm is completed with the manual buttons of alarm, they are activated by hand in case of fire.

Means of extinction of fires.
The performance on the fire comports.
- Elimination of the fuel.
- Suffocation, consists in acting on the comburent agent.
- Cooling, deleting the energy of activation.

Extinguisher agents.
Main agents are: water, foam, carbonaceous anhydride, powders and halons.
Water: It is the most used extinguishing substance. It acts like cooling and stifling fires, since evaporation produces steam of water that covers the fire, hampering the contribution of oxygen. Joining its advantages of economy, abundance, availability and safety, presents the inconvenience that it disperses the fire, produces considerable harms and can not be used where there are electrical risks.

Foams: They are bubbles of air or gas, generally aqueous, floating in the surface of the liquids because of his low density preventing the fuel from continuing in contact with the air. It presents the problem of not being able to be used in electrical fires and be very corrosive.

Carbonaceous anhydride: It is a gas that liquefies by compression and cooling having to store in suitable containers, when downloading the CO2 out of the container expands producing a species of snow known like carbonaceous snow, which acts like stifling. In front of the advantages of not being toxic, application in electrical fires, not producing deteriorations, presents the problems of not being able to apply to fires with embers.

Powders: The advantages of being applicable to electrical fires and not being toxic present the problem of not being able to be used in machines or delicate installations and have danger of reflation of the fire when ceasing the contribution of powder.

Halons: They are halogenated hydrocarbons. They are very good inhibitors and good stifling, no corrosives and do not drive the electricity, but are toxic to the environment, can not apply to fires with embers and are high cost. In actuality because of the certainty that causes harm irreparable on the layer of ozone already almost does not use (8).

Systems of extinction.
In pharmacies laptops are used. They are enclosed containers with a extinguishing substance inside that can be projected and directed on a fire by the action of an inner pressure. It is obtained previously by compression. It is necessary to comment some data of interest:

-they Have to maintain full charged in operation conditions and planted in suitable places.
- We have to plant them in easily visible places. Generally in passing places, maintaining a free area of obstacles.
- The extinguishers will be identified by the agent extinguisher contained and the class of fire against which has to apply.
- His location will be vertical, to a height of 1,2 m from the soil to the base of the extinguisher.
- It has to be inspected periodically to verify his state of load.
- To choose the extinguisher the nature of the fuel or class of fire has to be taken into acount, also environmental conditions, toxicity of the agent, etc.

Lighted up with emergency and signage.
This is the lighted up that has to go in operation automatically when a failure of diet in the lighted up usually is produced, and facilitate the visibility in case of emergency or evacuation of the edifice by a fire. Only they have to be feeding by their own sources of energy, no by sources of external supply.

It has to work at least during an hour, providing a minimum illumination of 5 lux. The base of the installation have to be autonomous squads in load continued, sufficiently protected, with underrum of canalisations and using conductive protected with resistant material to the fire (9).

CONCLUSION

After these simple calculations it is concluded that community pharmacies are places that present a risk of tall fire, therefore it is urged for the authorities inspectors of the sanitary administration to step up the verification that in the pharmacies fulfill all the norms of security to protect the users and to the workers of the pharmacies.

BIBLIOGRAPHY

1. National Safety Council. Wokplace safety. (Internet). (Acces December,14 2021). Available https://www.nsc.org/workplace
2. SEPE Europe.Risk calculation and fire safety. (Internet). (Acceso December,14 2021). Available http://www.framemethod.net/indexen_html_files/FRAME%20Risk%20calculation%20and%20fire%20safety.pdf
3. South Yorkshire Fire and Rescue. Community fire risk Model. (Internet). (Acces April, 14 2021). Available http://www.syfire.gov.uk/wp-content/uploads/2015/04/Community-Fire-Risk-Model.pdf
4. Sakenaite J, Vaidogas E.R. (2010). Fire risk indexing and fire risk analysis: a comparison of pros and cons. (Internet). (Acces December, 14 2021. Available http://dspace.vgtu.lt/jspui/bitstream/1/519/1/1297-1305_sakenaite_

vaidogas.pdf
5. Instituto de Seguridad e Higiene en el Trabajo (INSHT). (2020). Calculador del nivel del riesgo intrínseco en establecimientos industriales. (Internet). (Acces December, 14 2021). Available https://herramientasprl.insst.es/Seguridadcontraincendios/Introducci%C3%B3n.aspx
6. Duarte Viejo G. (2019). NTP 600. Reglamento de seguridad contra incendios. (Internet). (Acces December, 14 2021). Available https://www.insst.es/documents/94886/327064/ntp_600.pdf/d5acef93-600c-4eca-b642-26aec9df9206
7. Villanueva Muñoz JL. (2019). NTP 100. Método de Gustav Purt. (Internet). (Acces December, 14 2021). Available https://www.insst.es/documents/94886/326853/ntp_100.pdf/e7a786ef-1d02-4bee-baff-0b8f801f44f8
8. SEPE Europe. Quantitative fire risk análisis: a method for defining building -specific risk- adjusted design fires. (Internet). (Acces December, 14 2021). Available https://www.sfpe.org/publications/sfpeeuropedigital/sfpeeurope9/issue9feature6
9. Zhao Y, Wang J. Application in entertainment places for risk assessment. Applied Mechanics and Materials. 2014. (Internet). (Acces April, 14 2021). Available https://www.scientific.net/AMM.668-669.1413