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STUDY ON OWBs SAFETY AT COLLEGE HOSTEL

Neelotpal Neelot
Master of engineering-Industrial safety engineering
Knowledge Institute of technology
Salem, India
neelotpal20@gmail.com

Prof. A.ChandraKumar
Assistant Professor & Academic Coordinator
Department of Mechanical Engineering
Knowledge Institute of Technology
Salem, India

Abstract—Boiler Safety is related to the boiler are going to specified.There are several types of boiler are present in which one of its type is Outdoor-Wood Burning Boiler (OWBB).The outdoor wood burning boiler are generally used for the Kitchen purpose.The hazards and the accident which can be happened in any situation and any time for that safety is needed. With respect to the title in project going through the safety of the boiler, their and needs which required for the safety of the Outdoor Wood Burning Boiler. Smoke caused by operating some OWBs can have serious health and air pollution impacts in addition to being a nuisance to neighbors. The smoke from OWBs can contain emissions of fine particulates, carbon monoxide and other organic products, such as formaldehyde, benzene and aromatic hydrocarbons that form incomplete combustion. When inhaled, fine particulates from smoke emissions are carried deep into the lungs and can impair lung function and aggravate existing medical conditions such as asthma, lung or heart disease. Exposure to some pollutants in smoke can even cause cancer. The objective of the study is to take the measures for the safety of the boiler mainly at High steam pressure and Low water level

Keywords—components of Boiler,

I. INTRODUCTION

Outdoor wood-fired boilers (OWBs), also known as outdoor hydronic heaters, are free -standing wood-burning devices that heat liquid (water or water-antifreeze) that is then pumped underground to provide heat and hot water to one or more structures. They are typically the size and shape of a small storage shed or mini-barn with a short smoke stack on top. OWBs may be used to heat homes, greenhouses, and other buildings, produce domestic hot water, heat swimming pools or hot tubs, and provide heat to agricultural operations such as dairies.

The boiler is one of the used to produce steam in industries and educational institutions for the purpose of producing steam. Boiler is one of the hazardous device unless it is provided with safety devices and should be properly maintained. Here, am assessing the hazard of the boiler which is located at the boy's hostel, KIOT college campus.

OWBs DIFFER FROM OTHER WOOD-BURNING APPLIANCES?

OWBs are much larger and differ in design, operation and emissions produced from the smaller indoor wood stoves, pellet stoves, fireplaces and barbeque pits. Following are some concerns that are unique to the operation of OWBs:

Smoke - Older model OWBs often employ a very primitive combustion technology that allows the unit to operate in "idle" mode for long periods of time. This type of operation causes very poor combustion and continuous, heavy smoke.

Short Stack Height - OWBs are typically equipped with a very short smoke stack. The short stacks and reduced draft of OWBs fail to disperse emissions adequately and can cause smoky conditions at or near ground level.

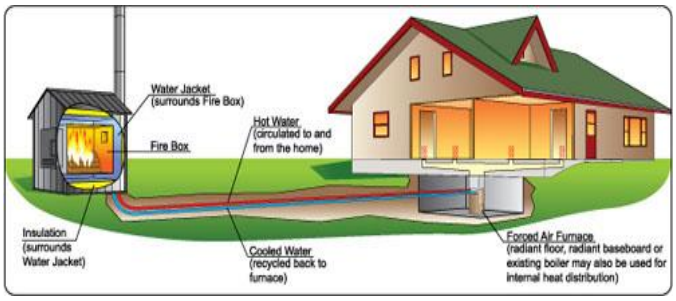
Year-Round Operation –

OWBs are used to heat houses, shops, domestic hot water, swimming pools, greenhouses, and spas. This means that smoke may be emitted year round, even in the summer when owners and neighbors want to enjoy the outdoors.

Fuel Choices - Because OWBs are designed with a large firebox and are located outdoors, some owners use them to burn household garbage, tires and other wastes, including hazardous waste. Burning these other substances in an OWB produces additional toxic and hazardous air pollutants.

AIR QUALITY CONCERNS ASSOCIATED WITH OWBS?

Smoke caused by operating some OWBs can have serious health and air pollution impacts in addition to being a nuisance to neighbors. The smoke from OWBs can contain emissions of fine particulates, carbon monoxide and other organic products, such as formaldehyde, benzene and aromatic hydrocarbons that form from incomplete combustion. When inhaled, fine particulates from smoke emissions are carried deep into the lungs and can impair lung function and aggravate existing medical conditions such as asthma, lung or heart disease. Exposure to some pollutants in smoke can even cause cancer. These residential furnaces are designed to heat an entire home and in many cases replace multiple indoor wood stoves, which are typically sized to a heat a single room. Both certified woodstoves and OWB are bulk-loaded with cordwood. In both, an air damper regulates the combustion process (manual in a woodstove, automatic in an OWB tied to a thermostat), and heat transfer is through the firebox surface to either the surrounding room (in the case of a woodstove) or a surrounding water reservoir (in the case of an OWB).



Particulate Matter (PM) and Polycyclic Aromatic Hydrocarbon (PAH) emission test data for OWB and EPA-certified woodstoves as

they are actually operated in people's homes were collected and compared.
The objectives were:

1).To compare OWB and woodstove emissions on a comparable heat input basis,
2) To examine the variation in OWB emissions over a wide range of burn rates and during unit cycling.

BOILER

According to the boiler act 1923:-

- "Accident" means an explosion of a boiler or steam-pipe or any damage to a boiler or steam-pipe which is calculated to weaken the strength so as to render it liable to explode;
- "Board" means the Central Board constitute under section 27 A;
- "Boiler" means any close vessel exceeding 22.75 liters in capacity which is used for generating steam under pressure and include any mounting or other fitting attached to such vessel, which is wholly or partially under pressure when is shut off'.
- "Chief Inspector", "Deputy Chief Inspector", and "Inspector" means, respectively, a person appointed to be a Chief Inspector, a deputy Chief Inspector and an Inspector under this Act'
- "Boiler" means a pressure vessel in which steam is generated for use external to itself by application of heat which is wholly or partially under pressure when steam is shut off but does not include a pressure vessel,

➢ With capacity less than 25 liters (such capacity being from the feed check valve to the main steam stop valve);

➢ With less than one kilogram per centimeter square design gauge pressure and working gauge pressure; or

➢ In which water is heated below one hundred degree centigrade.

➢ "boiler component" means steam piping, feed piping, economiser, superheater, any mounting or other fitting and any other external or internal part of a boiler which is subject to pressure exceeding one kilogram per centimetre square gauge;
➢ "Chief Inspector", "Deputy Chief Inspector", and "Inspector" mean, respectively, a person appointed to be a Chief Inspector, a Deputy Chief Inspector and an Inspector under this Act;
➢ "Competent Authority" means an institution recognised in such manner as may be prescribed by regulations for issue of certificate to the welders for welding of boiler and boiler components;
➢ "Competent Person" means a person recognised in such manner as may be prescribed by regulations for inspection and certification of boilers and boiler components during manufacture, erection and use. All Inspectors shall be ipso facto competent persons;
➢ "economiser" means any part of a feed-pipe that is wholly or partially exposed to the action of flue gases for the purpose of recovery of waste heat;
➢ "feed-pipe" means any pipe or connected fitting wholly or partly under pressure through which feed water passes directly to a boiler and which does not form an integral part thereof;
➢ "Inspecting Authority" means an institution recognised in such manner as may be prescribed by regulations for the inspection and certification of boilers and boiler components during manufacture.
➢ All Chief Inspectors of Boilers shall be ipso facto Inspecting Authorities;
➢ "manufacture" means manufacture, construction and fabrication of boiler or boiler component, or both;
➢ "manufacturer" means a person engaged in the manufacture;
➢ "owner" 14[includes any person possessing or] using a boiler as agent of the owner thereof and any person using a boiler which he has hired or obtained on loan from the owner thereof;
➢ "Prescribed" means prescribed by regulations or rules made under this Act.
➢ "Steam-pipe" means any pipe through which steam passes, if—

(i) the pressure at which steam passes through such pipe exceeds 3.5 kilogram per square centimeters above atmospheric pressure; or
(ii) such pipe exceeds 254 millimeters in internal diameter and the pressure of steam exceeds 1 kilogram per square centimeters above the atmospheric pressure, and includes in either case any connected fitting of a steam-pipe;

➢ "Structural alteration, addition or renewal" means,—
(i) any change in the design of a boiler or boiler component;
(ii) replacement of any part of boiler or boiler component by a part which does not conform to the same specification; or
(iii) any addition to any part of a boiler or boiler component;

➢ "superheater" means any equipment which is partly or wholly exposed to flue gases for the purpose of raising the temperature of steam beyond the saturation temperature at that pressure and includes a re-heater;
➢ "Technical Adviser" means the Technical Adviser appointed under sub-section (1) of section 4A.

KEY COMPONENTS OF BOILERS

Boilers are part of a hydronic heating system. Hydronic systems use water to transfer heat to a distribution source, like a radiator, to heat a home. Hydronic systems can heat via hot water or steam, depending on the type of boiler used. The boiler is the part of the system that heats the water to be distributed. The key elements of a boiler include the burner, combustion chamber, heat exchanger, exhaust stack, and

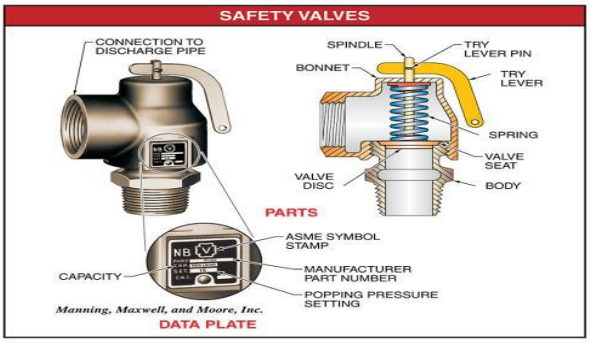
controls. Boiler accessories including the flue gas economizer are also commonly used as an effective method to recover heat from a boiler.

Key Components of Boilers are:-

Burner – The burner is the component of boiler that provides the heat that heats the water of system. The fuels used can be natural gas or oil.
Heat exchanger – The heat exchanger of boiler allows the heat from the burner to heat the water in system. The job of the heat exchanger is to carry the heat from the burner to the water without having direct contact with the water. It's a similar idea to boiling water in a pot.
Supply lines – Hydronic heating systems use piping to deliver the heated water or steam to the distribution points, and the supply lines are the pipes that distribute the hot water or steam to distributor.
Return lines – When the water cools, or the steam cools and changes states back to water, the return lines bring this water back to the boiler for re-heating.
Firebox – The firebox is where the fuel of system meets the air, creating a flame.
Refractory – Refractory actually refers to refractory materials that are used for filling any gaps and/or openings that may be around the fire box – this helps ensure the fire stays in the fire box.
Circulator pumps – circulator pumps push the hot water or steam from system to the heat distributors in our homes.
Deaerators/Condenser – Deaerator and condenser tanks are only used in steam boiler systems and not in hot water and hot oil boil because here the fluid always is on liquid form. The construction of these two types of tanks is almost identical, but as their names suggest, they are used for different purposes. Two primary principles are used with this form of tank design: thermal and vacuum. This depends on which type of boiler being used. Each principle also has different pump construction requirements.

SAFETY DEVICES FOR BOILER

SAFETY VALVES-
The spring-loaded pop-off safety valve pops open when steam pressure exceeds the MAWP. The safety valve spring applies pressure to close the valve disc against the valve seat. (MAWP Maximum allowable working pressure). The spindle aligns the valve disc with the valve seat. The try lever is connected to the spindle with the try lever pin. When the try lever is lifted during testing. Safety valve capacity is the amount of steam, in pounds per hour (lb/hr), that the safety valve is capable of venting at the rated pressure of the safety valve. The safety valve capacity is listed on the data plate attached to the safety valve. For example, if the safety valve capacity is listed as 6900 lb on the data plate, the safety valve can discharge steam at 6900 lb/hr. The safety valve capacity must equal or exceed the boiler pounds per hour rating.

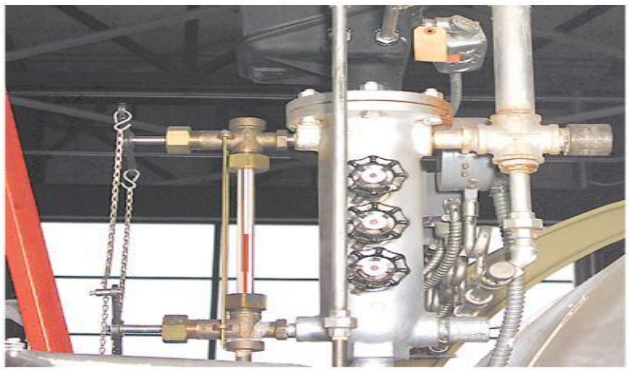


STEAM TRAPS- A steam bound feed water pump is a condition resulting from water pumped that becomes too hot and turns to steam. The feed water pump is designed to pump liquids, but does not work with air or steam. To correct a steam bound feed water pump, water fed to the feed water pump must be cooled.

Water that is drawn from a condensate return tank may be cooled by adding water from the makeup system. Cool water can be carefully poured directly on the feed water pump without spilling water on the motor if the problem persists. Steam traps on the condensate return line should also be tested for proper operation. In this example the steam trap is checked for operation with a hand held thermal temperature device.

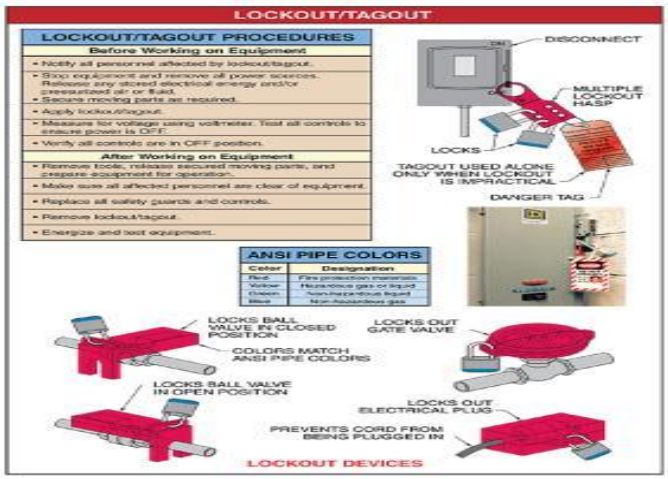
WATER LEVEL/NOWL:–
The Normal Operating Water Level (NOWL) should be approximately in the middle of the gauge glass. Ensuring proper water level may be the most important duty of an operator. The gauge glass is the primary devise used in determining water level and must be maintained in proper condition. It is connected to the water column which levels out the turbulent water in the boiler so it can be

read.



LOCKOUT/TAGOUT:–

Lockouts and tagouts are applied to equipment to prevent equipment operation during maintenance and repair. Lockout is the use of locks, chains, or other physical restraints to positively prevent the operation of specific equipment. Tagout is the process of attaching a danger tag to the source of power to indicate that the equipment may not be operated until the tag is removed. Space on the danger tag may be used to specify lockout information. A tagout does not prevent the startup of equipment, but serves as a warning to operating and service personnel. Lockouts and tagouts are removed only by authorized personnel. A multiple lockout requires installation and removal of more than one lock on a multiple lockout hasp. OSHA would require the use of locks in most cases.



BOILER LOG – A boiler room log is used to record information regarding operation of the boiler during a given period of time. The number and frequency of the checks to be performed depend on the plant. Some plants maintain a log for every 8-hour's period. Other plants maintain a log for a 24-hour's period. Maintaining a boiler room log allows the operator to evaluate the past performance of the boiler. In addition, boiler room log information can be useful in determining the cause of a malfunction and/or predicting a possible problem.

BOILER ROOM LOG

Month	Sunday	Monday	Tuesday	Wednesday	Thursday
BOILER OPERATION DATA					
Boiler on Line					
Pressure (psi)					
Stack Temp					
Condensate Return Temp					
Feedwater Heater Temp					
Fuel Oil Tank Temp					
Fuel Oil Pump Suction Pressure					
Fuel Oil Pump Discharge Pressure					
Fuel Oil Temp at Burner					
Outside Temp					
BOILER OPERATOR DUTIES					
Blowdown					
Gauge Glass					
Water Column					
Low Water Cutoff					
Test Flame Scanner					
Safety Valve Test*					
*Tested once a month when boiler is coming off the line.					
Fuel Oil Accessories					
Change Over Strainer & Clean					
Clean Fuel Oil Burner					
Fuel Oil Gauge Readings					
Start of Shift					
End of Shift					
Gal. Consumed					
Operator's Initials					
Special Instructions:					

2. Methodology

EXPERIMENTAL SET UP / TESTING / DATA COLLECTION

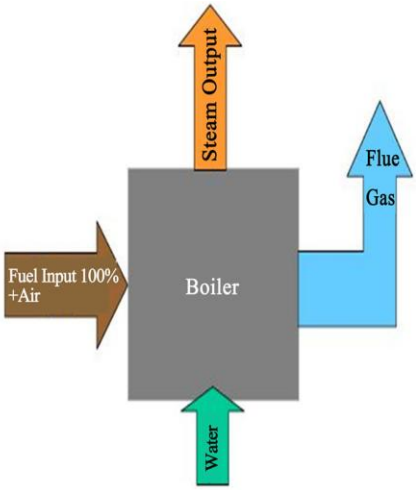
BOILER EFFICIENCY CAN BE TESTED:-

A boiler is an enclosed vessel that provides a means for combustion heat to be transferred to convert water into steam. A boiler is a complex integration of evaporator, reheater, super heater, economizer, air preheater along with various auxiliaries such as pulveriser, fans, etc. The purpose of the performance test of boiler is to determine actual performance and efficiency of the boiler and compare it with design values. It is an indicator for tracking day to day and season to season variation in boiler efficiency and energy efficiency improvements to control unit heat rate. The efficiency of a coal fired boiler is quoted as the % of useful heat available, expressed as a percentage of the total energy potentially available by burning the coal. This is expressed on the basis of gross calorific value (GCV) coal. Most standards for calculation of boiler efficiency, including IS 8753, ASME Standard: PTC-4-1 Power Test Code and BS845 are designed for measurement of boiler efficiency. Unvaryingly, all these standards do not include blow down as a loss in the efficiency determination process.

Basically Boiler efficiency can be tested by the following methods:

1. Direct Method or Input Output Method.
2. Indirect Method or Heat Loss Method.

DIRECT METHOD or INPUT OUTPUT METHOD:- Where the energy gain of the working fluid (water and steam) is compared with the energy content of the fuel. This is also known as „input-output method" due to the fact that it needs only the useful output (steam) and the heat input (fuel) for evaluating the efficiency



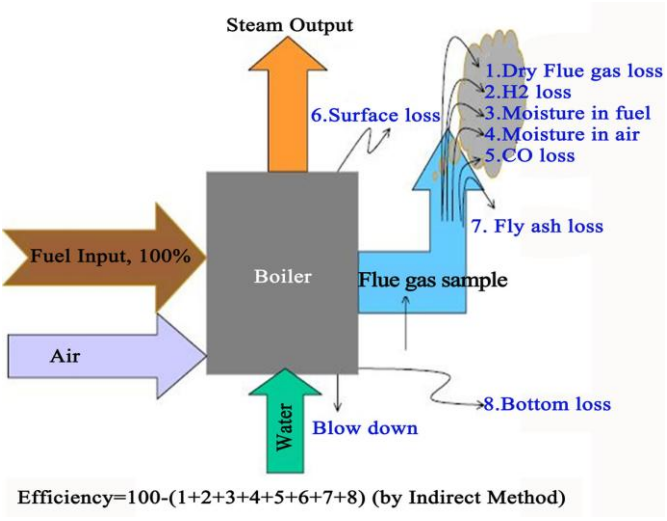
$$\text{Efficiency}=\frac{\text{Heat addition to Steam} \times 100}{\text{Gross Heat in Fuel}}$$

$$\text{Boiler Efficiency}=\frac{\text{Steam flow rate} \times (\text{steam enthalpy}-\text{feed water enthalpy})}{\text{Fuel firing rate} \times \text{Gross calorific value}} \times 100$$

FIG: (a) - Direct Method or Input Output Method

INDIRECT METHOD OR HEAT LOSS METHOD:-

Where the efficiency is the difference between the losses and the energy input. The efficiency can be measured easily by measuring all the losses occurring in the boilers using the principles to be described. The efficiency can be arrived at, by subtracting the various heat losses from 100.



where:-L1- Loss due to dry flue gas (sensible heat) L2- Loss due to hydrogen in fuel (H2) L3- Loss due to moisture in fuel (H2O) L4- Loss due to moisture in air (H2O) L5- Loss due to carbon monoxide (CO) L6- Loss due to surface radiation, convection and unaccounted L7- Loss due to Unburnt in fly ash (Carbon)L8- Loss due to Unburnt in bottom ash (Carbon).

Measurements Required For Performance Assessment Testing

The following parameters need to be measured, as applicable for the computation of boiler efficiency and performance.
a) Flue gas analysis:-percentage of CO2 or O2 in flue gas, Percentage of CO in flue gas, Flue gas temperature
b) Flow measurement:-Steam, Fuel, Feed water Condensate water, Combustion Air
c) Temperature measurement:-Steam, Feed water, Condensate return, Flue gas
d) Pressure measurement:-Steam, Flue gas Combustion Air
e) Ultimate analysis for H2, O2, C, S, moisture and ash content.

Pre Inspection Checklist for Low Pressure Steam Boiler

As the American Society of Mechanical Engineers (ASME) Section IV and Section VI for heating boiler

According to (ASME):-A minimum clear space of 18 inches (18") shall be provided on all side of the boiler. All low pressure stem boilers shall be constructed, stamped, and installed in conformance with section IV of the (ASME). All low pressure boiler trains shall comply with the requirement of ASME CSD-1

Instruments, Fittings, and Controls:-

Each steam boiler shall have a steam gage or a compound steam gage connected to its steam space or to its water column or to its steam connection. The gage shall contain a siphon. The gage connection to the boiler shall not be less than NPS ½ inch. Where steel or wrought iron pipe is used the gage connection to the boiler shall not be less than NPS ½ inch. The scale on the dial of a low pressure steam gage shall graduate to not less than 30 psi nor more than 60 psi. The water column drain pipe and valve shall be not less than NPS ¾ inch. The lowest visible part of the water gage glass shall be at least 1 inch above the lowest permissible water level recommended by the boiler manufacturer.

Installation Requirements:-

Safety valves and safety relief valves shall be located in the top or side of the boiler. Coil or header type boilers shall have the safety valve or safety relief valve located on the steam or hot water outlet end. Safety valves and safety relief valves shall be installed with their spindles vertical. Safety valves and safety relief valves shall not be connected to an internal pipe in the boiler. Steam boilers having a capacity of 25 gal or less are exempt from the above valve sizing requirements, except that they must have a ¾ NPS minimum drain valve connected to the lowest water containing space.

Preaction Checklist of Steam Boiler

Design, Inspection, Testing and ASME- Coded Pressure System & Safety Relief Valves:-

Performing design, repairs, significant repairs of a routine nature, and alteration of boilers, Pressure vessels, pressure piping, and other American Society of Mechanical Engineering (ASME) - coded pressure system. To repairs to existing boilers, pressure vessels, and piping; and to, Inspection and testing of safety relief valve in accordance with the Jurisdictional requirements and latest editions of the (ASME) Boiler and pressure Vessel Code, (ASME) codes for Pressure Piping (B 31), and National Board Inspection Code (NBIC). Power boilers (ASME Boiler and Pressure Vessel Code, Section I,

"Power Boilers"). Heating boilers (ASME Boiler and Pressure Vessel Code, Section IV, "Heating Boilers"). Unfired pressure vessels (ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels"). Safety relief valves. Steam systems with a designed operating pressure above 15 psig. Air systems required to control or actuate boilers, regardless of pressure, up to the point where air is regulated or controlled for instrument use. Liquid systems (for example, water, oil, chemical solutions) with a designed operating pressure above 30 psig. Air or gas systems (argon, carbon dioxide, nitrogen, helium, etc.) with a designed operating pressure above 15 psig. Hydraulic distribution systems as defined in ASME Code for Pressure Piping, B31.1, "Power Piping."

3. Conclusion

This paper is convergent on the diverse aspects of the operation of Outdoor Wood Burning Boiler efficiently. Efficient operation of boiler is likely to play a very big role in following years to come. The suspension cost of such system is expected to be very high. Hear applying of standard method of ASME and in respect of BOILER ACT 1923. To get away with this challenge, it is clearer by this paper. We have to use the advanced technology and management skills in all spheres of activities to perform its effective role in Outdoor Wood Burning Boiler.

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