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Abstract:

An improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications. The fire test facility is constructed with double porous staggered walls to form a closed indoor testing facility which ensures ambient wind effects are neutralized and near-uniform flow of air enters the fire from all over the height. Such an improved fire test facility can be used in a wide range of industrial and domestic fire safety testing applications.

Complete Specification

Claims:I/We Claim:
1. An improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment, said system comprising: a closed indoor testing facility constructed using a plurality of double porous staggered walls which ensures neutralizing of ambient wind effects and uniform flow of air for the fire from all over the height of the facility.

2. The system of claim 1 comprising a pool-fire location at the center of the facility within the double porous staggered walls where the combustion fuel is burnt for the testing and validating of the fire safety equipment.

3. The system of claim 1 comprising a chimney above the pool fire location wherein the height of the roof portion of the facility is set such that all of the visible flame is very much below the roof and the smoke and hot gases emanating from the fire are drawn away from the top region via. the chimney.

4. The system of claim 1 comprising the porous double walls are designed to draw air from different heights uniformly and ingest at appropriate altitudes where visible flame is present wherein the ingesting of air to the height of flame enables effective combustion of fuel.

5. The system of claim 1 comprising the porous double walls aims at efficient supplying of air to the fire at the pool-fire location to create a steady and productive combustion through natural ingestion of air through the porous walls of the facility.

6. The system of claim 1 comprising the porous double walls are made porous with double wall staggered arrangement where the wind stream is broken into smaller eddies and pass through a non-straight path to ensure that directionality of the wind is broken and the air uniformly moves towards the fire.

7. The system of claim 1 wherein the chimney is created as a top opening which is one-and-a-half size more than the pool-fire location/pan which draws in the hot gases and straightens up the fire within the fire test facility.

8. The system of claim 1 comprising the porous double walled indoor fire test facility can be a rectangular structure with an appropriate height for conducting fire tests.
, Description:POROUS DOUBLE WALLED INDOOR FIRE TEST FACILITY
TECHNICAL FIELD

[001] The present invention generally relates to the fire safety testing facilities and techniques. The present invention also relates to fire safety equipment and testing methods. The present invention further relates to improvements to indoor fire test facilities. The present invention is more particularly related to an improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications.

BACKGROUND OF THE INVENTION

[002] Large fire test facilities for testing and validating the fire safety equipment and accessories are well known in the art. Such fire safety testing facilities are large indoor facilities designed to support a wide range of industries, government and academia in fire resistance research, technology development and testing. The fire test facilities are engaged built to work with the construction, transportation, aerospace, and automotive industries and other advancing technologies for improving the fire safety of buildings and transportation systems, enhancing fire detection and suppression systems, and reducing the risks and costs of fire. Many of the modern testing facilities are adaptable to a wide range of testing needs to meet industry and association standards including Indian Standards, UL Standards (USA), European Standards and/or other standards for conducting custom tests for research and development purposes.

[003] Such testing facilities typically require an indoor volume of space that has adequate height to take away the incomplete products of combustion of the fires established over a pan fire (typically of measurement 2 m x 2 m) with n-heptane, large cribs with standard wood specifically for testing fire extinguishing agents. The scale of the fire is large: The 2 m x 2 m pool fire burns for 1minute consuming about 20 kg and delivering fire power of 13 MW and generates incomplete products of combustion of 200 kg, the equivalent volume at the exhaust at the exhaust temperature of 200 °C is 4500 cubic meters over a minute.

[004] Also typically, a 10A crib during its peak power delivers 6 MW thermal power with exhaust gases of 2000 cubic meters at 200°C. In order that the fires be established properly, air has to be delivered into the system at about 60 to 70 cubic meters per second over one minute. Typical sizes of the rooms vary from facility to facility, but are in the range of 13 m x 18 m x 13 m high or 15 m x 15 m x 15 m.

[005] Conventional prior art facilities adapt heavy duty blowers operating at around 300 KW to deliver the air into the bottom zone all around the room nearly uniformly all across the room from the bottom region. The uniformity is achieved by supplying the air into large plenum created through a wide channel all around the inner wall from which air enters via perforations. The dirty combustion gases are evacuated from the top region using another blower that has to draw about 20 to 40 times the volumetric flow, cleaned up for soot and other products of incomplete combustion before they are let out into the atmosphere.

[006] Such prior art facilities require to be designed with very high (typically 15-20 m) walls or the size of fire never exceeding a value, the difference between the rate of exhaust and the rate of hot gas generation leads to accumulation inside the indoor facility with the smoke descending to alarmingly low levels making normal operation unsustainable even for short durations of test (typically about 2 minutes).

[007] Alternatively, the air is allowed through louvers around the wall. Such a system needs manual opening of the louvers and is maneuvered to ensure that large winds from one side are restricted to minimize the wind effects on the fire. Furthermore, the limitation of such prior art devices is that the ambient winds change directions randomly and the size of higher speed wind streams can vary from very small to large. While the large ones may be tackled, the small ones are very difficult to tackle and cause sudden changes in the flame profile and also changes in the burn rate.

[008] Many other alternative fire testing solutions were proposed to address the challenge. Such prior art solutions include: University of Waterloo's facility which uses fans to generate 40 km/h wind speeds over fuselage like structures with an active exhaust system over the inclined roof. South Korea ship and off-shore research institute has created a fire test facility for clearance of several fire safety equipment using an active exhaust system on the inclined roof.

[009] Spain has a fire atrium test facility in Murcia with a pyramidal roof with four roof exhaust fans pumping 37 m3/s for testing fires of about 4 MW. China has a fire test atrium at Hefei, Anhui designed to study large space building fires with a combined mechanical and natural ventilation strategies. Such conventional prior art systems have mechanical ventilation in full or in-part. Use of such mechanical ventilation needs to be accompanied by hot gas clean up strategies even for maintaining the facility in good operating condition, apart from the need to clean up the smoke in the hot gas.

[0010] Based on the foregoing, a need therefore exists for an improved testing facility design for testing and validating fire safety equipment and accessories. A need also exists for an improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications, as described in greater detail herein.

SUMMARY OF THE INVENTION

[0011] The following summary is provided to facilitate an understanding of some of the innovative features unique to the disclosed embodiment and is not intended to be a full description. A full appreciation of the various aspects of the embodiments disclosed herein can be gained by taking the entire specification, claims, drawings, and abstract as a whole.

[0012] Therefore, one aspect of the disclosed embodiment is to provide for an improved fire safety testing facility for industrial and domestic applications.

[0013] It is another aspect of the disclosed embodiment to provide for an improved system for indoor pool fire tests at ambient temperature for testing fire extinguishing media and equipment.

[0014] It is a further aspect of the disclosed embodiment to provide for an improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications.

[0015] The aforementioned aspects and other objectives and advantages can now be achieved as described herein. An improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications, is disclosed herein. The fire test facility is constructed with double porous staggered walls to form a closed indoor testing facility which ensures ambient wind effects are neutralized and near-uniform flow of air enters the fire from all over the height. A pool-fire location is formed within the double porous staggered walls where the combustion fuel is burnt for the testing and validating of the fire safety equipment.

[0016] The height of the roof portion of the facility is set such that all of the visible flame is very much below the roof and the smoke and hot gases emanating from the fire are drawn away from the top region via. a chimney above the pool fire location. Such an improved fire test facility can be used in a wide range of industrial and domestic fire safety testing applications such as, but not limited to, construction, transportation, aerospace, and automotive industries and other advancing technologies.

[0017] The porous double walled indoor fire test facility disclosed herein aims at efficient supplying of air to the fire at the pool-fire location to create a steady and productive combustion through natural ingestion of air through the porous walls of the facility throughout the height. The fire test facility with porous double wall is designed to draw air from different heights uniformly and ingest at appropriate altitudes where visible flame is present. Such a feature of ingesting of air to the height of flame enables effective combustion of fuel without any additional blowing units or support units. In general, the height of the flame can be a maximum of three times the fire diameter described by the pool-fire location/pan containing thick layer of liquid fuel, such as, for example, n-heptane, diesel or alcohol.

[0018] The porous double walled indoor fire test facility can be a rectangular structure with an appropriate height for conducting fire tests. For example, for conducting fire test on a 2.1 m x 2.1 m pool fire, the facility can be of 13 m x 20 m rectangular structure with a height of 11 m. In order to design a double staggered porous wall, the porosity of the wall was chosen as 40 % coverage to the total wall size. For a typical 20 B (2.1 m x 2.1 m) standard fire, the height of flame can be 6 m height over which air must be allowed to be uniformly ingested without allowing for higher speed streams.

[0019] It is therefore, the entire wall of the facility is made porous with double wall staggered arrangement to ensure that the wind stream is broken into smaller eddies and pass through a non-straight path to ensure that directionality of the wind is broken and the air uniformly moves towards the fire. The chimney of the facility is created as a top opening which is one-and-a-half size more than the pool-fire location/pan which draws in the hot gases and straightens up the fire within the fire test facility.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The drawings shown here are for illustration purpose and the actual system will not be limited by the size, shape, and arrangement of components or number of components represented in the drawings.

[0021] FIG.1 illustrates a graphical representation of an improved porous double walled indoor fire test facility for evaluating and testing fire safety equipment for use a wide range of industrial applications, in accordance with the disclosed embodiments; and

[0022] FIG. 2 illustrates a graphical representation illustrating the velocity profiles of the porous double walled indoor fire test facility, in accordance with the disclosed embodiments.

[0023] FIG 3 illustrates wind measurement in indoor fire lab sonic anemometer.

DETAILED DESCRIPTION

[0024] The particular values and configurations discussed in these non-limiting examples can be varied and are cited merely to illustrate at least one embodiment and are not intended to limit the scope thereof.

[0025] The embodiments now will be described more fully hereinafter with reference to the accompanying drawings, in which illustrative embodiments of the invention are shown. The embodiments disclosed herein can be set out in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0026] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0027] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0028] FIG.1 illustrates a graphical representation of an improved porous double walled indoor fire test facility 100 for evaluating and testing fire safety equipment for use a wide range of industrial applications, in accordance with the disclosed embodiments. The fire test facility 100 is constructed with double porous staggered walls 110 to form a closed indoor testing facility which ensures ambient wind effects are neutralized and near-uniform flow of air enters the fire from all over the height. A pool-fire location 120 is formed within the double porous staggered walls 110 where the combustion fuel is burnt for the testing and validating of the fire safety equipment.

[0029] The height of the roof portion of the facility 100 is set such that all of the visible flame is very much below the roof and the smoke and hot gases emanating from the fire are drawn away from the top region via. a chimney 130 above the pool fire location 120. Such an improved fire test facility 100 can be used in a wide range of industrial and domestic fire safety testing applications such as, but not limited to, construction, transportation, aerospace, and automotive industries and other advancing technologies.

[0030] The porous double walled indoor fire test facility 100 disclosed herein aims at efficient supplying of air to the fire at the pool-fire location 120 to create a steady and productive combustion through natural ingestion of air through the porous walls 110 of the facility 100. The fire test facility 100 with porous double wall 110 is designed to draw air from different heights uniformly and ingest at appropriate altitudes where visible flame is present. Such a feature of ingesting of air to the height of flame enables effective combustion of fuel without any additional blowing units or support units. In general, the height of the flame can be a maximum of three times the fire diameter described by the pool-fire location/pan containing thick layer of liquid fuel, such as, for example, n-heptane, diesel or alcohol.

[0031] FIG. 2 illustrates a graphical representation 200 illustrating the velocity profiles of the porous double walled indoor fire test facility 100, in accordance with the disclosed embodiments. The velocity profiles calculated using Fire Dynamics Simulator showing velocities of the order of 0.5 m/s. The calculations were made by the use of fire dynamics simulator which confirms the expectation of undisturbed flow field inside the fire test facility 100.

[0032] The porous double walled indoor fire test facility 100 can be a rectangular structure with an appropriate height for conducting fire tests. For example, for conducting fire test on a 2.1 m x 2.1 m pool fire, the facility can be of 13 m x 20 m rectangular structure with a height of 11 m. In order to design a double staggered porous wall, the porosity of the wall was chosen as 40 % coverage to the total wall size. For a typical 20 B (2.1 m x 2.1 m) standard fire, the height of flame can be 6 m height over which air must be allowed to be uniformly ingested without allowing for higher speed streams.

[0033] Simultaneous experimental measurements of wind velocities inside as well as outside the porous wall enclosures over a typical windy day using sonic anemometers are shown in Fig. 300. These are indicative performance of porous wall. Green lines are out door velocities about 3 meters from wall. Blue and red lines are velocities pan. It is seen that indoor velocities are very low (0.2 to 0.3 m/s) and the environment inside qualifies to be 'indoor' condition.

[0034] The fire was intended to burn for 60 seconds at which time extinguishment process would start as a part of Underwriter Laboratories standard fire extinguishment test to qualify extinguishing media. The amount of air to be provided must be comparable to the outdoor fire demand since the test procedure was not to be compromised due to lack of air drawn by the fire in a natural manner. The total amount of air to be supplied is 70 m3/s and the thermal power of the fire was calculated as 13 MW.

[0035] The entire wall 110 of the facility 100 is made porous with double wall staggered arrangement to ensure that the wind stream is broken into smaller eddies and pass through a non-straight path to ensure that directionality of the wind is broken and the air uniformly moves towards the fire. The chimney 130 of the facility 100 is created as a top opening which is one-and-a-half size more than the pool-fire location/pan which draws in the hot gases and straightens up the fire within the fire test facility 100.

[0036] It will be appreciated that variations of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Also that various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.