گرماتاب

Radiant Heater

ارائه شده به: دکتر نوعی

توسط: مصطفی ساغری دوز

پروژه درس: انتقال حرارت 2

نیمسال دوم سال تحصیلی 85-84

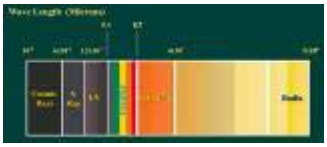
گروه مهندسی شیمی

دنشگاه فردوسی مشهد

بخش دوم: مطالب زبان اصلی

Understanding Infrared Radiant Heaters Better

To make practical application decisions on the use of high or low intensity infrared heaters for space heating, it is helpful to have a very basic understanding of electromagnetic energy. All of the energy that we receive from the sun is broadly identified as electromagnetic (e.m.) waves to which physicists ascribe properties of wavelength and frequency.



Indeed it has been found that wavelength times frequency equals a constant which is 3 x 108 m/sec., the speed of light.

About 3% of the sun's e.m. energy is ultraviolet or shorter in wavelength, about 50% is in the visible light band and about 47% of the energy is in infrared wavelengths and longer. It is only the infrared wavebands that supply the earth with heat energy.

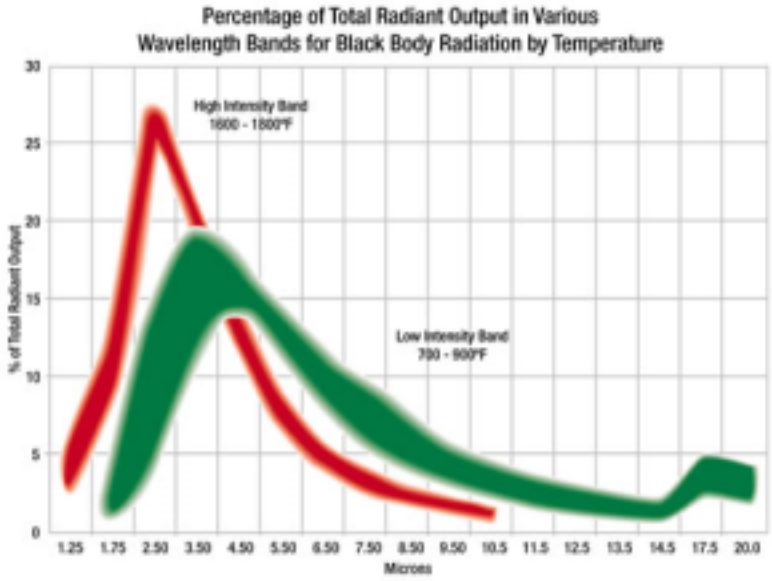
All physical bodies are able to absorb and emit e.m. energy and there is a relationship between temperature, which is a measure of the heat charge of the body (as voltage is for electricity), and the wavelength of energy that the body emits. As the temperature of the emitter rises, the dominant wavelengths grow shorter and the frequency goes up.

Infrared cameras are able to receive and record e.m. energy and assign a colour on a screen to each magnitude of wavelength. The intensity and colour seen by an eye on the screen is a translation of the amount of e.m. energy of that particular wavelength measured by the camera's receiver.

For infrared radiant heaters all of the foregoing physics principles apply. High intensity heaters, so called because the frequency band of their emitted energy is broadly higher than low intensity, operate at nominal emitter temperatures of 1600 – 1900º F. The result is that 80% of the emitted e.m. energy is in wavelengths from approximately 1 to 6 microns (10-6 meters). In practical terms, this means that the energy band is quite close to the energy band of the visible light spectrum and therefore we see the emitter as a reddish colour. The brighter the colour, i.e. tending towards orange and yellow, the shorter the average energy wavelength of the emitter.

Low intensity heaters operate in a temperature range from about 600ºF to 1100ºF with corresponding e.m. wavelengths of 2 to 10 microns. This is farther away from the visible light spectrum and therefore no light is emitted, i.e. there is no glow.

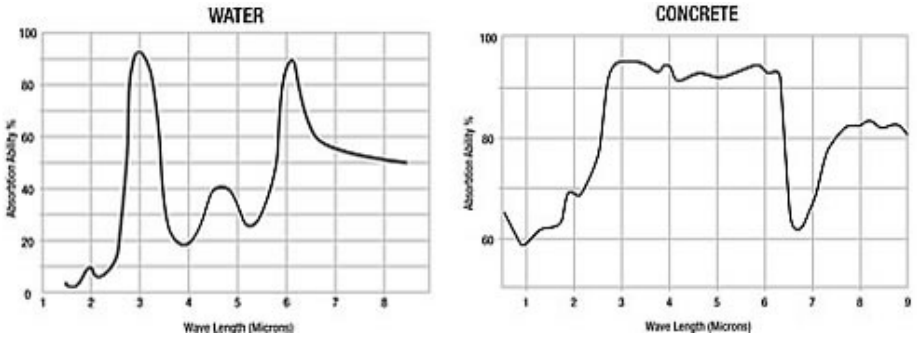
The following chart illustrates the foregoing.



eg. at 1800ºF (High Intensity Heater) 25% of the total emittance is at 2.8 microns; at 900ºF (Low Intensity Heater) 15% of the total emittance is at 4.5 microns.

In deciding on a heating appliance for a certain space, the first obvious question is; which heater, high or low intensity will perform best for me? To reach a conclusion, the broad question must be broken into several simpler questions, which we can answer on the basis of straightforward physics.

1. **Does a higher radiant efficiency in a high intensity heater, i.e. the increased conversion of thermal energy to radiant energy, automatically provide improved space heating? The answer is no!**
   We know from the previous physics principles that as we supply more thermal energy to a given emitter, the temperature rises and likewise the average frequency of the emitted e.m. energy rises. For example, as the radiant efficiency of a given area high intensity heater is improved more and more, it produces more and more energy at the top end of its frequency band (as evidenced by a shift in colour to a brighter, whiter colour). We are also aware that white light possesses little heating qualities. An incandescent tungsten filament lamp operates at about 2000ºF and produces negligible infrared energy. The conclusion; as infrared heaters get pushed more into the luminous wavelengths, their overall infrared heating qualities actually begin to decrease.
2. **Do materials absorb all wavelengths of e.m. energy in the same way? The answer is no!**
   We will limit our discussion here to concrete and water as recipients of infrared energy because these are the largest heat sink constituents of a space heating application. Concrete represents the floor of the structure and water represents the human body (which is 97%, by weight, water). All elements have their own unique affinity for the absorption of certain wavelengths of e.m. energy. The following graphs are those for concrete and water.



We note that water has an affinity for wavelengths of 3 and 6 microns; concrete has an affinity for wavelengths from about 3 to 6 microns. The obvious conclusion is that infrared heaters that produce an increasing amount or infrared energy above 3 microns, while their radiant efficiency may indeed be quite high, are producing **unusable** e.m. energy; energy that cannot be absorbed by the major heat sinks in the space.

3. **Is installed distance a factor in preferring high or low intensity heating equipment? For all practical purposes, the answer is no!**

   The intensity of the output of an infrared heater is largely a function of temperature, which in turn is a measure of the heat per unit area of the emitter (we are assuming a thin emitter face). 100,000 BTUH through an emitter of 3 square feet will feel far more intense than the same output for an emitter area of 30 square feet. To release an assumed BTUH from a smaller area will require a higher temperature. The higher temperature "drives" the e.m. energy off the emitter face faster. However, as we saw previously, this will result in a generally higher frequency e.m. distribution, which may not achieve an improved heating efficiency.

   As evidenced by the action of the sun, infrared energy travels through space and reaches the earth with little apparent loss. The energy can be intercepted by dust and moisture particles, e.g. clouds. Unless there are clouds in the building, the infrared energy of a high or low intensity heater of equal BTUH rating will equally reach the furthest point in the heating application.

In spite of the addition of reflectors, commonly available high intensity heaters operate virtually as spot sources of e.m. energy. Figure A is representative.

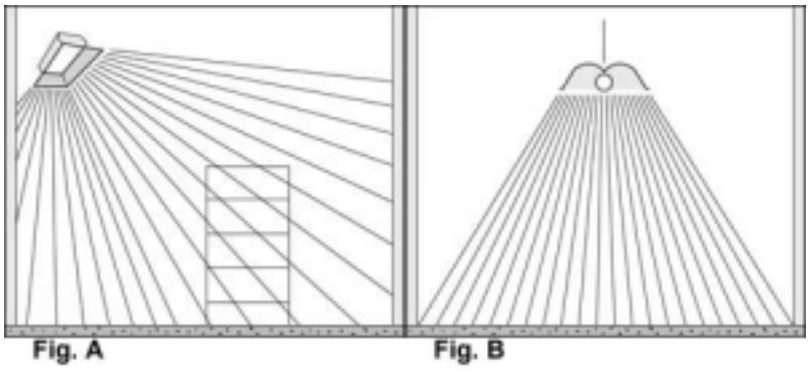


Fig. A Fig. B

A low intensity heater with a properly designed reflector will generate a heat pattern per Figure B. In good infrared space heating design, infrared radiation that impacts high up on the walls of the structure is of little use. Worse, this energy raises the skin temperature of the

wall; increases the temperature gradient across the wall and increases the heat loss of the building.

4. **Does the thermal efficiency rating for high and low intensity offer a good criteria for a choice between the two appliance options? The answer is no!**

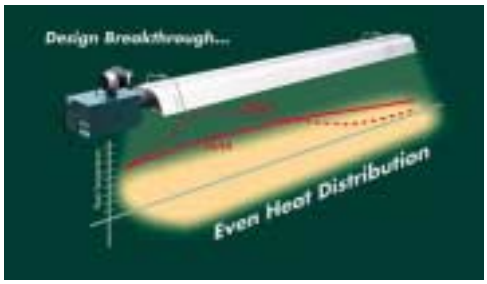
   Thermal efficiency is an engineering criteria that can be used only with a vented appliance.

By definition of its physical design, all the thermal energy consumed by a high intensity heater remains in the building space and the thermal efficiency is therefore 100%. Low intensity infrared heaters, if vented to the outside, can have thermal efficiency percentages from the mid 70s to the high 80s. Whenever unvented heaters are used, mandated building codes require that fresh air be brought into building at the rate of 3 cubic feet per minute for every 1,000 BTUH of heat. I.e. building codes require the addition of 18,000 cubic feet of fresh air per hour for a 100,000 BTUH heater. If we assume a marginal Southern Ontario heating demand this can represent about one half of the building's volume every hour. Regardless of individual manufacturers claims, if we regard a building and its infrared heating equipment as **a total system**, the **"thermal efficiency of the total system"** for high intensity is nearer 50% than 100% and certainly less than for a low intensity system where far less ventilation is required.

****

Radiant Tube Heaters

Radiant Tube Heaters are a designing breakthrough that gives even heat distribution for natural gas or propane heaters.



Infrared heater for garages

Low Intensity Infrared Heaters

High Intensity Infrared Heaters

Infrared tube heaters are quick and easy to install if you are in need of a heat source for a shop, attached garage, barn, patio, or entry way. Radiant tube heaters are a great way to distribute heat in any building or outdoor area. Infrared heats the objects (including you!) but not the air, unlike a warm air system- saving you money on your heating bills. In other words, the air temperature can be reduced for the same comfort levels. With radiant heat, the heat does not accumulate at the ceiling but rather it puts the heat where you need it. This radiant heat can save you up to 20% or more on heating costs over the conventional warm air methods.

****

FP Flat Panel Infrared Heaters

FP Flat Panel Infrared Heaters are very efficient infrared heat sources in that as much as 80% of the applied energy is converted into radiant energy. Typical ratings are 10-15 watts per square inch. The FP Flat Panel Infrared Heater's advantage versus radiant elements such as quartz tube, metal sheath tubular and ceramic is the complete, wide area, uniform coverage provided. A broad range of standard sizes and ratings can form the modular base of a radiant heating system. Custom sizes and ratings can also be designed for special or unique applications. The standard material, Quartz Cloth, a cleanable Black Glass and extra-durable Stainless Steel emitter surfaces are available. Because of the rugged construction, FP Infrared Heaters are resistant to shock and vibration. No reflectors are required, eliminating maintenance requirements. Without insulation, the overall thickness is 1-1/2" - with insulation, 3". Thermowells can be installed near the surface for precise control of the sheath temperature. By controlling the sheath temperature, the wavelength can be matched to the specific absorption characteristics of the material being heated.

****

Ceramic infra red heating

Ceramic infra red heaters have high temperature ceramic emitters, which emit harmless, invisible infra red waves. These waves pass through the air until they strike a surface, at which point their energy is turned into heat.

Ceramic infra red heating is very efficient because:

- Ceramic infra red heating heats people and objects directly, not the air surrounding them. This means thermostats can be set several degrees lower without any noticeable reduction in comfort levels.
- Ceramic infra red heating provides instant heat. In most circumstances, there is no need to pre-heat rooms.
- Nearly 100% of the infra red energy is converted to heat when it strikes a surface.

By comparison, warm air heating first heats the air, which in turn heats the building and its occupants. The heat losses associated with warm air heating are substantial, and increase with the building size and ceiling height. A long pre-heat period is often necessary to 'bring the building upto temperature' before it feels comfortable.

Ceramic infra red heating - comfort and health

Occupants of buildings heated by ceramic infra red heating feel comfortable even if the room temperature is relatively low, because they are warmed directly by the infra red heaters. Objects and surfaces, such as chairs, desks, equipment etc. are also warmed by the infra red

waves, and feel warm to the touch, further increasing the perception of comfort.

Ceramic infra red heating is unaffected by mechanical ventilation. High volume ventilation can be used to remove noxious fumes and dust, maintaining a fresh and clean environment, without reducing comfort levels.

Ceramic infra red heaters don't have fans, they are completely silent, and don't disturb dust and airborne particles.

Because infra red heating doesn't heat the air, it doesn't dry it out, so building occupants don't complain about dry or sore throats.

Electric ceramic infra red heating - benefits

Electric ceramic infra red heating does not produce fumes, odours or water. It has no moving parts and unlike gas infra red heating doesn't require regular servicing to maintain its efficiency. It is easily controlled using manual switches, timeswitches or passive infra red detectors (PIR), and is quick and cost effective to install.

****

Electrical radiant heaters - frequently asked questions

This page answers the most common questions we are asked about our wall mounted electrical radiant heaters.

Is my building suitable for electrical radiant heaters?
Electric radiant heaters are suitable for use:
In buildings that are **poorly insulated, drafty**, have **high ceilings**, or where **doors or loading bays are kept open**.

For **heating specific areas** inside larger spaces. I.e. production lines or workstations.

In buildings that are **unoccupied for long periods**, such as churches, village halls, etc.

How do electrical radiant heaters work?
Electrical radiant heaters work in the same way as the sun. They produce rays that pass through air without heating it, when the rays hit a surface or person; the energy is converted to heat.

Can I install them myself?
The HS500, HS1500, HS2000, HS3000 can be fitted with a standard 13A plug, which you can do yourself. **The HS4500 cannot be used with a 13A plug**.

Activair wall mounted heaters which are permanently connected to an electricity supply (i.e. not fitted with a 13A plug), must be installed by a qualified electrician.

Where should they be positioned?
Radiant heaters are most effective when they are installed on opposing walls.

How are they fixed to the wall or suspended?
All Activair radiant heaters are supplied with a tilting wall bracket. Additionally all models **except the HS500** are supplied with a corner bracket.

There are also cut-outs in the back of the heaters through which suspension chain or wire can be fed, and small holes for self tapping screws to attach suspension eyes.

How much heat do electrical radiant heaters produce?
Unlike warm air heaters, which heat the air, that in turn heats surrounding surfaces. The energy from a radiant heater directly heats the surface it is pointed at, so for any given size of heater they feel much warmer.

You make 5 sizes of radiant heater, which is most suitable for me?
The HS3000 is our most popular model - it offers the best balance between heat output and cost, and is the biggest model which can be fitted with a 13A plug for temporary or DIY installation.

How critical are the recommended mounting heights?

Try to mount the electrical radiant heaters as closely as possible to the heights given. Mounting them higher reduces the watts/square metre decreasing the heating effect. Mounting them lower increases the heating effect, which can cause overheating.

Are there any mounting restrictions?

The casings of our electrical radiant heaters do get hot. It is important the minimum air gaps are adhered to.

Nothing should be placed within 1 metre of the front of the heater, and it should not be pointed directly at combustible surfaces.

What is the difference between 'zone' and 'spot' heating?

Zone heating refers to heating different parts (zones) of an area to different levels. For instance extra heat may be used around loading bays.

Spot heating is used for drying, curing or de-icing surfaces.

Can I use your electrical radiant heaters for 'spot heating'?

Yes,

What do electrical radiant heaters cost to run?

Multiply the size of electrical radiant heaters (in Kw) by the cost of one unit of electricity (from your electricity bill) this will give you the running cost for one hour.

Can I use your electrical radiant heaters in food preparation areas?

Yes, because they don't contain glass, and the ceramic emitters are shatterproof, there is no risk of food contamination.

Because electrical radiant heaters do not dry the air, they are particularly suited to packhouses, production lines, fruit grading lines, etc. to provide workers with comfortable working conditions while minimising deterioration of the produce.

Can I use your electric radiant heaters in shower rooms or around swimming pools?

Yes, the ceramic emitters are unaffected by water splashes. However, the electric radiant heaters must be mounted out of the reach of occupants.

My new electrical radiant heater makes loud popping/cracking noises, is this normal?

This is caused by expansion as the heater warm up; it will stop after a few minutes. The noise stops completely after the heater has been used for a few days.

****

Radiant infrared heater - wall mounted

Activair **wall mounted infrared radiant heaters** are designed for heating commercial and industrial buildings such as garages, factories, warehouses, churches, gymnasiums, etc.

They produce beams of infrared energy which heat people and objects directly without warming the surrounding air. Making them ideal for large, open or drafty buildings, where conventional warm air heating using fan heaters would be uneconomical.

Heavy duty wall mounted radiant heaters

Activair wall mounted radiant heaters are ruggedly constructed from galvanised steel, coated with a tough stone coloured epoxy powder finish. They have no moving parts, are virtually maintenance free, and will provide years of trouble free operation.

Tough, durable and safe wall mounted radiant heaters

Activair wall mounted radiant heaters are fitted with ceramic infrared emitters which unlike halogen tubes don't produce an uncomfortable glare, and are are completely harmless to the eye, even after prolonged exposure.

Ceramic emitters are very tough, and unlike glass halogen tubes and will not shatter or explode, making suitable for use in food processing areas, or where the general public are present.

مراجع . . .

موتورهاي جستجو:

www.google.com
www.yahoo.com
www.parsik.com

مطالب و تصاوير:

www.bigchiefheaters.com
www.hayters.net
images.google.com
www.yahoo.com
www.superiorradiant.com
www.garmataab.com
www.tombling.com/heaters/ceramic-infra-red-heating.htm
www.tombling.com/heaters/electrical-radiant-heaters.htm
www.imagine.gsfc.nasa.gov.docs

خبرگزاري ايسنا
سازمان بهينه سازي مصرف سوخت