Dictionary of Applied Energy Conservation

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Preface

The escalating cost of energy is drawing an ever increasing number of people into the planning and execution of energy conservation measures and programmes and confronts them with the specialist terminology of the conservationist. The object of this illustrated dictionary is to list the generality of terms employed in energy conservation practice and to explain, with the aid of appropriate illustrations, the basic definitions and underlying techniques.

I trust that this publication will prove of valuable assistance to all concerned with saving energy, be they architects, industrialists, managers or lay public.

David Kut, *August 1982*

Acknowledgements

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Picture Acknowledgements

The author and publishers would like to express their thanks to The Architectural Press Ltd for permission to reproduce various illustrations from their books. The sources of the illustrations are as follows: *Applied Solar Energy;* figure numbers 1, 2, 7, 10, 11, 47, 71, 103 to 106, 118, 119. *Waste Recycling for Energy Conservation;* figure numbers 3, 8, 9, 13, 18 to 24, 31, 37, 39, 40, 48 to 52, 56, 68, 69, 73 to 75, 77, 89 to 93, 96, 100, 102, 107, 114. *District Heating and Cooling for Energy Conservation;* figure numbers 17, 25 to 30, 32, 36, 45, 46, 57 to 59, 61, 62, 64, 65, 70, 72, 76, 78, 79, 85, 94, 98, 101, 111 to 113, 115.

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In compiling this illustrated dictionary I have necessarily drawn on many sources, but I wish to acknowledge particularly the information I have derived from the following books:

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Contents

absolute air filter See *air filter – absolute.*

absolute humidity See *humidity – absolute.*

absolute temperature The temperature at which there is no heat energy left in a body (– 273°C). Expressed in degrees Kelvin. To convert conventional temperature to absolute temperature, add 273.6 to Centigrade temperature (456.7 to Fahrenheit temperature).

absorptance The ratio of the radiant energy absorbed by a plane surface to the radiant energy incident upon that surface. (See figure 1.)

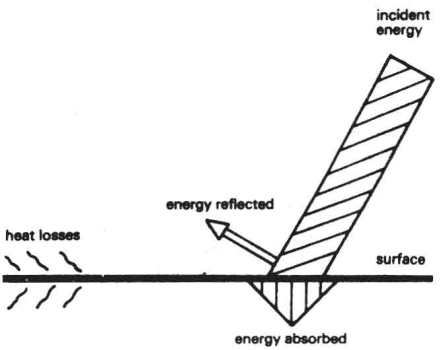

Figure 1 Absorptance

absorption The process by which radiation is converted within a material into excitation energy. Most of the radiant energy falling (or incident) upon a matt black surface is absorbed.

absorption chiller Equipment utilising the principle of absorption refrigeration. See *absorption refrigeration.*

absorption refrigeration Substitutes a heat source (gas firing, steam or medium pressure hot water) for the compressor in the conventional chiller. The heat vaporises the absorbent, usually lithium bromide; it is then taken through a cycle of operation which includes concentrating and condensing the absorbent, evaporation of the liquid and spraying of same into an absorber, from which the dilute solution is returned to the concentrator. Alternative to compressor operated vapour refrigeration system. Reduces operating costs where cheaper heat sources are available (possibly surplus steam during the summer air-conditioning season). Relatively costly and space consuming with associated cooling tower plant. (See figure 2.) *Application:* general use; in particular for energy recovery where there is available surplus heat.

absorptive attenuator Attenuator that incorporates glass fibre and mineral wool materials, and that is effective over a wide range of freq uencies.

accumulator A vessel in which heat is accumulated during a period of slack demand for heat and discharged at times of high demand.
Steam: Useful in circumstances where a relatively high proportion of the total steam demand is required or met at a pressure which is substantially below the steam main from the boiler and where steam is at times in surplus and available for storage.
Application: waste heat system associated with incinerators where the incineration process is continuous and the steam demand fluctuating; wherever there are advantages in maintaining constant steam production or back-pressure steam feed in a situation of varying steam demand.
It has been found practicable in many cases to adapt redundant Lancashire boilers as accumulators.
Hot water: Large, efficiently insulated storage vessel in which the hot water is heated during periods of surplus steam availability for use of hot water at times of high demand for hot water.

acid condensation The deposition of acid out of acid-containing gas or vapour when cooled below the dew point of the acid. Relates particularly to chimney flue gases; acid condensation can cause major damage to chimney and associated installation and therefore must be avoided.

acid dewpoint Refers particularly to chimney operation in which the flue gases have an acid content (eg sulphur). Cooled below the acid dew point, the acid will condense out of the flue gas.

actimatic grease interceptor See *grease interceptor – actimatic.*

activated carbon filter Activated carbon granules located in position by a glass fabric on either side of the air filter panel. The filter assembly is then placed into the air stream which is to be filtered, offering adequate area to air flow.

activated carbon filter

Activated carbon has the ability to absorb vapours or gases in adequate capacity for purposes of commercial air filtration. This ability derives from the nature of its surfaces, which are made up of myriads of sub-microscopic pores.

Activated carbon filters are widely employed for the removal by absorption of body odours, tobacco smells and fumes, cooking smells, etc. Only a relatively brief period of contact is required between the activated carbon and the air being filtered.

The carbon material employed in air filters is selected for its properties of fine porosity, absorption and durability to resist abrasion and crushing during manufacture and handling.

When handling fairly dirty air, as is commonly the case in cities and in industrial areas, a fabric type or other suitable pre-filter must be placed into the air stream upstream of the activated carbon filter to reduce the dust burden on that filter, leaving the filter to deal mainly with vapours and gases.

The state of the activated carbon filter medium is usually monitored by a test panel fitted to each filter section. The panels are removed after a specified period of service and are subjected to a laboratory test to assess the likely life of the main filter medium in the circumstances of a particular installation.

Activated carbon filters are particularly useful in applications where a high proportion of ventilation air must be recirculated, where cooking smells can cause offence, etc.

activated silica A highly effective coagulant aid which is prepared from sodium silicate 'activated' by various chemicals.

active system Relates to solar energy collection. Refers to a system which utilises *external* energy (commonly electricity or possibly gas) in the collection and/or exploitation of the solar energy; for example, hot water system which incorporates a circulating pump; warm air collector and distributor which rely on fan(s) and electric motor(s); heat pumps employing compressor, condenser fan and automatic controls.

adiabatic process A process during which no exchange or transfer of heat occurs between a system and its surroundings. It can only occur if (1) no temperature difference exists or (2) the system is thermally insulated from its surroundings. These qualifications indicate that a true adiabatic process cannot be achieved in practical engineering, as there is no known perfect heat insulator. By controlling the temperature of the immediate surroundings, so that it always equals (or almost equals) that of the system, a very close approach to an adiabatic process can be achieved.

Application: compression of a gas in a refrigeration compressor – adiabatic compression may be assumed in computing the theoretical power requirement of the process.

adsorption A process caused by the mass

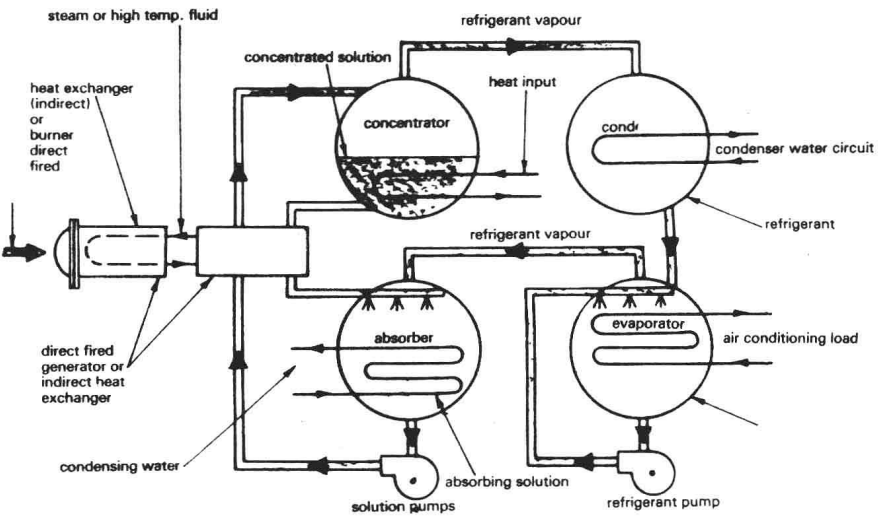

Figure 2 Absorption refrigeration diagrammatic arrangement of process

migration of the vapour molecules from the air to the adsorbent because of a higher vapour pressure in the air than exists within the pores of the adsorbent substance.
Some adsorbents are selective relative to the vapours they will attract into themselves. Eg silica gel, when exposed to a mixture of vapours, will invariably adsorb the water vapour from the mixture; charcoal will ordinarily adsorb odourbearing vapours. Thus silica gel is well suited to dehumidification applications; charcoal to the purification of air and odour control.

a/e ratio The ratio of absorption coefficient for solar radiation to the emission coefficient at operating temperature; it is a measure of the selectivity of absorber surfaces.

aeration The practice of exposing small droplets of water to air to encourage the absorption of oxygen from the atmosphere or the release of other gases in order to effect beneficial changes in the water.

aerobic corrosion See *corrosion – aerobic.*

aerodynamic noise generation In general, caused by air (at high velocity) flowing around or against surfaces (such as duct splitters, elbows without guide vanes, dampers blades, diffusers, grilles, etc) and resulting in turbulence. Noise can be re-radiated from an attenuated section to break out in an unattenuated section of the duct system.
It is of particular concern and importance in modern high-velocity air systems, with air flowing above 10m/s and at pressures of up to 20mb.
Can be avoided or rectified by careful design of ducted air systems and by selective application of sound attenuation.

aerogenerator A machine for converting wind energy and electric power. Growing number of applications in Europe and USA of projected outputs up to 4 MW per unit. UK Central Electricity Generating Board plans wind farms with individual outputs of up to 1MW fed into the electricity grid. Modern aerogenerators of large output are mounted atop towers up to 100m high and may have blades of up to 40m long.

after-cooler Associated with air-compressor systems. Fitted between air compressor and air receiver. Cools the compressed air to ambient temperature after compression; this permits majority of the water vapour in the air input to condense and be removed before it enters with the air into the receiver. Usual cooling medium is water. Common design basis: 5.5°C (10°F) temperature rise of the cooling water; air temperature cooled within 11°C (20°F) of the water inlet temperature. Oil and moisture must be drained off periodically. Presence of these pollutants can be a major factor in the failure and breakdown of control equipment of the compressed air system.

airborne thermal infra-red heat loss survey Airborne thermal infra-red line-scan equipment for locating energy losses from external surfaces of buildings, storage vessels and pipelines due to structural or material defects. Surveys are carried out during the winter heating period.
Application: energy conservation schemes for manufacturing plants, chemical works, hospitals, public buildings, etc.

air-circulating ovens Use an air-recirculation system as opposed to the traditional approach of expelling the air after one pass through the working chamber. A heat exchanger can be sited in the burner exhaust duct if required.
Application: storing, curing and heat treatment ovens or any other process oven requirement.
Energy-saving potential: the air-recirculation system reduces heat input by up to 60 per cent over a dead-loss system. Additional benefit is obtained with the use of the heat exchanger.

air classifier Employed in waste separation and recycling to direct the different separated materials into their respective discharge streams. Basically, comprises a blower, a rotating drum fitted with an internal helix and a large engagement chamber. In use, a current of air is directed along the drum, and the sized feed is allowed to fall through the air stream, so that any paper and plastic in the mixture are carried along the drum and into the disengagement chamber. The dense objects fall through the air stream and are conveyed to the opposite end of the drum by the internal helix. (See figure 3.)

air conditioner Term applied to an assembly of air-conditioning equipment, usually within one package.
Packaged: Compact air-conditioning unit in which all the essential components are assembled into one unit.
Split type: Package air conditioner in which the evaporator is in its own cabinet; the compressor and condenser (the relatively noisy and vibratory) equipment is usually located externally to the air-conditioned space, but connected to the evaporator cabinet by insulated pipes. Such arrangement provides a

quieter air-conditioning environment and facilitates layout planning. Capacity range up to about 5kw.
Feasible to have the compressor packages with either the evaporator or the condenser; the latter is more usual.

air-conditioner – window type: Packaged air-conditioner assembly fitted into window of air-conditioned space, so that condenser faces to the outside. Permits simple installation.
Disadvantage: relatively high noise level in air-conditioned space (depending on model) and unsightly external appearance.

air conditioning (comprehensive) Provides control of temperature (heating and cooling), relative humidity, air condition (filtration) and air movement within the treated environment.

air conditioning – fan-coil system See *Fan-coil air-conditioning system.*

air conditioning – induction system See *Induction air-conditioning system.*

air conditioning – two duct system See *Two-duct air-conditioning system.*

air conditioning – variable volume system See *Variable volume air-conditioning system.*

air conditioning Versatemp system See *Versatemp air-conditioning system.*

air controller – rhomboidal See *Rhomboidal air controller.*

air curtain A cold or warm air curtain with adjustable blast direction control. Single side, top blow or double side blow units are available. Wind velocities up to 15 mph, depending on conditions, can be resisted. Warm air curtains available from which warm air from door heater is discharged directly into the work area as a prime source of heating. A door-actuated switch directs the air blast across the door only when the door is open.
Application: to prevent escape of warm air from heated space.

air diffuser Duct system terminal fitting which discharges air into a space. Consists of a number of metal cones with the air outlets between the cones.
Each configuration provides a characteristic air-flow pattern. The designer must select same to suit the particular application.
Diffusers may be circular or rectangular (square).

air filter Assembly of dust-, gas- or dirt-absorbing surfaces fitted into a ducted system to clean the air passing through it. The filter sheet metal housing is usually provided with flanges for attachment to ductwork. There are many types of filter and filter media to suit the various filtration requirements encountered in research and industry.

air filter – absolute Fabric dry-type filter unit suitable for filtration at ultra-high efficiency down to 0.01 micron particle size. Will remove dust, bacteria, virus concentrations, etc. Employs as filtration medium a special form of glass-based paper containing a proportion of finely corded, long asbestos fibre or similar material.
Application: hospital, clean room, research, etc situations.

air filter – bag Comprises a series of filter bags within the filter assembly. Can be made to provide a high-filtration efficiency by suitable specification of filter medium. Can incorporate automatic dust-shaking device. Can handle large dust load.

air filter – ceramic Used in the removal of acid mists and in compressed air filtration. Suitable

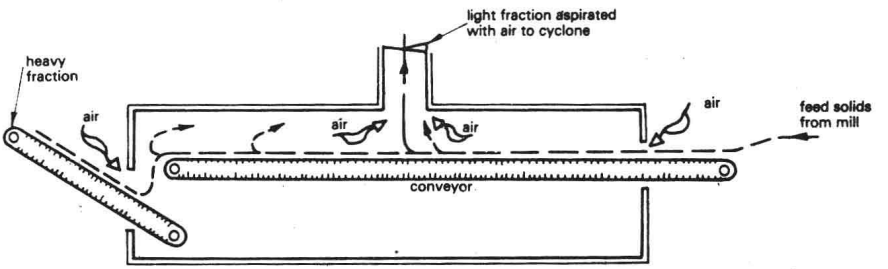

Figure 3 Principle of the enadimsa horizontal air classifier

for use on high-pressure and high-temperature applications (500°C (932°F)).
Can be made suitable to withstand thermal shock.

air filter – electrostatic Has three major components: ionizer, dust collector and electronic power pack. Ionizer comprises a series of earthed tubes; between adjoining tubes is stretched a fine metal wire charged to about 13,000 V direct current (d.c.). When the ionizer wire is charged positively, the amount of ozone present in the filtered air is not increased beyond that found in the atmosphere at sea level on a normal sunny day.
A strong electrostatic field is set up across the space between the ionizing wire and the earthed tube surface, and, at the correct voltage, a corona discharge takes place from the wire, causing ionization of the air molecules, which are thereby greatly accelerated. When a dust particle carried by the air stream passes through this space, it is met by a stream of ions travelling outwards from the ionizing wire. Collision with this stream ionizes the dust particles and causes these to become impelled in the direction of the collector cell, which consists of a number of flat, parallel, vertical plates; one set is earthed and the second set charged to approximately 6000 V. The plates are arranged alternately so that the air and the dust flow along narrow passages with an earthed plate on one side and a charged plate on the other. The electrostatic field between the plates in the collector cell draws the dust particles to the earthed plate, to which they adhere until removed.
Cleaning of the electrostatic filter is carried out by washing down the cells with warm water; it is often found convenient to install sparge pipes for this purpose. The permissible length of time between cleaning operations depends on the location of the plant, the proportion of air recirculation and the season of the year (much more frequent cleaning than normal would be required during periods of a heavy London fog).
Sumps with adequate drain connections and water seals must be provided, the object of the seals being to prevent ingress of unfiltered air via the drains. Man-access to the filter is through air-tight doors with safety locks, interlocked with the power pack to prevent opening of the access doors unless the electric supply to the filter unit has been switched off. (See figure 4.)

air filter – fabric-type Uses a fabric filtration medium (as opposed to liquid, metal, etc). Suitable for filtration down to 2 micron particle size. Material must be suited to the application and may have to be flame and fire resistant in certain instances.

air filter – gauge Indicates filter resistance. Can incorporate warning lights.

air filter – grease filtration type Used in conjunction with cooking and similar equipment which generates suspended grease. Is usually located at the outlet(s) of the exhaust canopy where this connects with the extract ducting. Filter cells are usually provided with means of easy handling and withdrawal for cleaning in suitable detergent solution and re-use.

air filter – pre-filter A coarse type of filter used ahead of main filter. Essential to protect

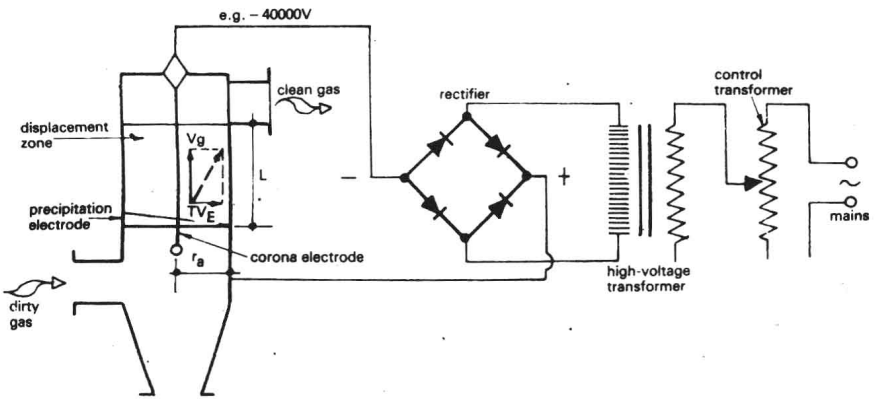

Figure 4 Electrostic air filter-diagrammatic arrangement

absolute, carbon and electrostatic main filters; otherwise employed where dust burden is great.

air filter – renewable-type The filter medium may be cleaned by compressed air or vacuum, or it may be a viscous liquid which is recycled through a suitable liquid cleaner.

air filter – roll-type Filtering material is wrapped around a drum which automatically advances to maintain an acceptably clean surface of filtration medium. An end-of-roll warning alarm or light indication must be provided to alert the maintenance staff to the need for roll replacement. Tends to provide relatively coarse filtering.

air filter – throwaway-type The filter medium is expendable. When saturated with the filtered material or when its resistance has become excessive, the material is removed, thrown away and replaced with new. The filter casing must have facilities for monitoring filter performance and must be provided with means of easy withdrawal. (See Figure 5.)

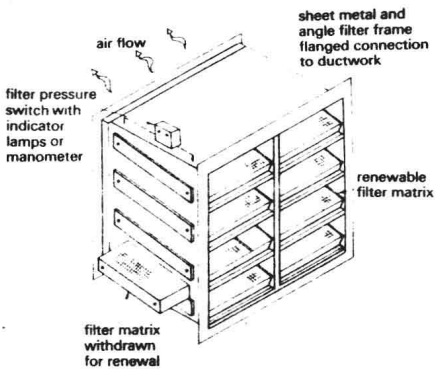

Figure 5 Air filter assembly – showing withdrawal facility

airfilter – vee-type Filter cells arranged in V formation inside the assembly to offer the greatest surface area to the air flow.

air flow – in ducts Rate of air flow in a duct system depends on:
resistance to air flow offered by air ducts and associated duct fittings;
density of the air being conveyed;
absolute viscosity of the air;
internal dimensions of ducts and fittings;
shape and air flow characteristics of the system components;
roughness of the duct wall.
Guidance on design air-flow systems is provided in *IHVE Guide*, section C4 (CIBS – Flow of Fluids in Pipes and Ducts, 1977).

air flow measurement Field measurements of air flow are required to establish that the completed system meets the design intent and to achieve a balance of air flow around the various sections of a ducted air system.

air governor – automatic Used in conjunction with air compressors. Provides for the continuous running of the compressor, but allows the plant to run under conditions of light load when a predetermined pressure has been reached in the air receiver. The driving unit (eg electric motor) will then be running on light load with a corresponding reduction in power consumption. When the demand for air increases, the pressure in the air receiver drops and the automatic air governor allows the compressor to resume operation. A hand-lifting device is often incorporated and enables any air under pressure from the air receiver to lift the governor valve and so pass into the unloading cylinder of the compressor (this ensures that the air compressor can be started up against frictional load only, even if air receiver and pipe lines are full of air under pressure).

air-handling luminaire Dual-purpose light fitting which embodies within one fitting the light source (tungsten or fluorescent) and a facility for supplying or extracting ventilation/air-conditioning air through the fitting. Extraction is more common and can be associated with energy-recovery system in which the heat given off by the light source is withdrawn into the extraction plant before it can raise the space temperature; this raises the temperature of the extracted air and suits it that much better for heat recovery via heat pump, recovery heat exchange coil or heat wheel.

air lift Method of raising water from a low to a higher level by the injection of compressed air.

air lock 1. Accumulation of air trapped in a pipe or vessel sufficient to reduce or stop the flow of the working fluid.
2. Space sealed by two doors to reduce the air change rate when moving from one set of air conditions to another.
3. Space arranged to prevent loss of conditioned air when entering or leaving.

air mass The length of the path through the earth's atmosphere traversed by direct solar

radiation, expressed as a multiple of the path length with the sun at zenith.

air – primary See *Primary air.*

air receiver Associated with air compressor equipment. Damps out the pulsations of the air delivered by the compressor, stores the air to provide a supply 'cushion', cools the air and removes the oil and moisture which is contained in the input air (usually in association with ancilliary equipment).
Each air receiver must be permanently marked with:
maker's identification number;
date of test;
specification number;
hydraulic test pressure;
maximum permitted working pressure.
Air receivers must be installed, maintained and periodically inspected under the provisions of the Factory Act. B.S. Nos. 429 and 487 relate to air receivers.

air requirement for combustion See *Combustion air requirement.*

air – secondary See *Secondary air.*

air-supply diffuser May be circular, square, rectangular or of slot-type. Permits good control over air-flow pattern. Variety of dampering methods available, eg by screwdriver inserted from front, quadrant control at rear, local adjustment at each slot diffuser. Engineered to suit particular circumstances and requires careful selection. (See figure 6.)
Application: for all types of air-conditioning and ventilation systems. Very large diffusers available for use in tall and large spaces.

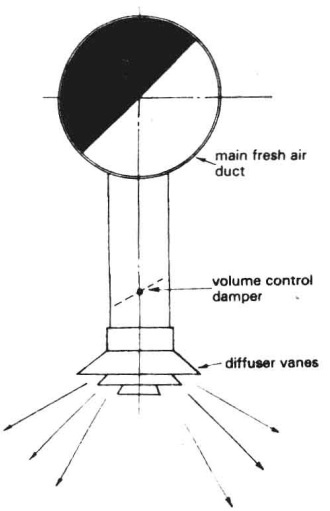

Figure 6 Circular air supply diffuser

air-supply nozzle Nozzle-shaped air-supply fittings suitable for applications which require a long air throw from the discharge. Tend to be noisy.
Application: air supply into large and tall areas, such as exhibition halls, factories.

air vent A device for removing air from a liquid system, either manually or automatically.

air vents for steam The air vents open to discharge air or an air/steam mixture and close against live steam. This is done automatically and irrespective of steam pressure.
Application: the main application of the equipment is to continuously remove air; for example, air vents work on steaming ovens, ironer beds, drying cylinders.
Energy-saving potential: eliminating 6 per cent of air in the steam supply to a unit heater can increase efficiency by 30 per cent. Removing air from a jacketed boiling pan can reduce cooking time by half. The automatic action of the vents enables machines to reach operating temperature rapidly, which can save fuel and avoid poor production.

air washer Employed with ventilation/air-conditioning systems. Sprays water into the air system to humidify, dehumidify or cool. May rely on evaporative cooling or operate with chilled water. Incorporates pump(s) and controls.

alarm monitor Related to underground (eg district heating, steam, condensate, etc.) insulated pipes using a small diameter cable (wire) which is incorporated into the insulated pipeline. In the event of a leak or of damage, the resistance of the cable changes and releases a visual or an audible alarm in the plant room or district heating station. Thermographic (infra-red photography) techniques can then be used to locate the exact position of the damage. Some pre-insulated pipe systems incorporate an alarm monitoring system.
Major advantage: early warning of damage; this should permit remedial action before the damage becomes more widespread and costly to repair.

alternative energy Term assumes that the fuels