Thermal Dynamic Lab Equipment 1-Basic Thermal Dynamics Principle

SR3025 Radial and Linear Heat Conduction

1.Experiment list:

Learning Objectives / Experiments, linear heat conduction (plane wall), determination of temperature profiles for different materials, determination of the temperature profile in case of a disturbance determination of the thermal conductivity lambda, radial heat conduction, determination of the temperature profile, determination of the thermal conductivity lambda

2.Specification

[1] investigation of heat conduction in solid bodies, [2] experimental setup consisting of experimental unit and display and control unit, [3] linear heat conduction: 3 measuring objects, heating and cooling element, 9 temperature measuring points, [4] radial heat conduction: brass disc with heating and cooling element, 6 temperature measuring points, [5] cooling by means of tap water, [6]electrical heating element

SR1158E Plate Heat Exchanger

1.Production profile

The key feature of plate heat exchangers is their compact design, in which optimum use is made of all of the material for heat transfer. The pressed in profile on the plates creates narrow flow channels, in which significant turbulence occurs. The turbulent flow allows effective heat transfer even with low flow rates and also has a selcleaning effect. self-cleaning effect. Plate heat exchangers are used in the food industry, offshore technology, refrigeration and domestic engineering.

2.Equipment feature

The SR1158E Plate Heat Exchanger is part of a series of units enabling experiments to be performed on different heat exchanger types. The experimental unit is ideally suited for investigating the functioning and behaviour of a plate heat exchanger in operation. The plate heat exchanger is made up of profiled plates with water flowing through the spaces between them. The plates are soldered in such a way that two separate flow channels are formed. These are one “cold” and one “hot” flow channel, in an alternating arrangement. Part of the thermal energy of the hot water is transferred to the cold water. Valves on the supply unit are used to adjust the flow rates of hot and cold water. The supply hose can be reconnected using quick-release couplings, allowing the flow direction to be reversed. This allows parallel flow or counter flow operation

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SR-WL377 Convection and Radiation

1.Description

Under real conditions, the heat transport between two objects is normally substance-bound, i.e. convection and/or heat conduction, and not substance-bound, i.e. radiation, at the same time. Determining the individual heat quantities of one type of transfer is difficult. Trainer enables users to match the individual heat quantities to the corresponding type of transfer. The core element is a heated metal cylinder located at the centre of the pressure vessel.

The surface temperature of the heated metal cylinder is controlled. Temperature sensors measure the surface temperature of the metal cylinder and the wall temperature of the pressure vessel. In addition to the heating power of the metal cylinder, it is possible to study the heat transport from the metal cylinder to the wall of the pressure vessel.

The pressure vessel can be put under vacuum or positive gauge pressure. In the vacuum, heat is transported primarily by radiation. If the vessel is filled with gas and is under positive gauge pressure, heat is also transferred by convection. It is possible to compare the heat transfer in different gases. In addition to air, nitrogen, helium, carbon dioxide or other gases are also suitable.

Heat transport by conduction is largely suppressed by adequately suspending the metal cylinder.

A rotary vane pump generates negative pressures down to approx. 0,02mbar. Positive gauge pressures up to approx. 1bar can be realised with compressed air. Two pressure sensors with suitable measuring ranges are available for the pressure measurement: a Pirani sensor measures the negative pressure while a piezo-resistive sensor measures the positive pressure.

The measured values can be read on digital displays. At the same time, the measured values can also be transmitted directly to a PC via USB, where they can be analysed with the software. Our price didn’t contain PC.

2.Technical details:

heat transfer between heated metal cylinder and vessel wall by convection and radiation, operation with various gases possible, experiments in vacuum or at a slight positive gauge pressure, electrically heated metal cylinder in the pressure vessel as experimental vessel

temperature-controlled heating element, vacuum generation with rotary vane pump, instrumentation: 1 temperature sensor on the metal cylinder, 1 power sensor at the heating element, 1 Pirani pressure sensor, 1 piezo-resistive pressure sensor, digital displays for temperature, pressure and heating power software for data acquisition via USB under Windows 7, 8.1, 10, Technical data, Heating element, output: 20W, radiation surface area: approx. 61cm2, Pressure vessel, pressure: -1…1,5bar, volume: 11L

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SR-WL376 Thermal Conductivity of Building Materials

1.Description

Thermal insulation in building planning is a sub-area of construction physics; it uses appropriate measures such as component design to enable a comfortable room climate all year round while at the same time consuming little energy. This is achieved by using building materials with high thermal resistance and low transmission by heat radiation.

The SR-WL 376 device is used to investigate various non-metallic building materials with regard to their thermal conductivity in accordance with DIN 52612. The scope of delivery includes samples made of different materials: insulating panels made of Armaflex, chipboard, PMMA (acrylic glass), styrofoam, Polystyrene-PS, Polyoxymethylene-POM, cork and plaster. The samples all have the same dimensions and are placed between a heated plate and a water-cooled plate. A clamping device ensures reproducible contact pressure and heat contact. The hot plate is heated by an electric heating mat. In the cold plate, the temperature is achieved by water cooling. Sensors measure the temperatures at the cooling water inlet and outlet and in the centre of both plates. The temperatures for the hot plate above the sample and for the cold plate underneath the sample are set using the software provided. A temperature control system ensures constant temperatures. The heat flux between the hot plate and the cold plate passes through the sample and is measured by a special heat flux sensor. The entire housing, including the cover, is thermally insulated to ensure constant ambient conditions. The measured values are transmitted directly to a PC via USB where they can be analysed using the software included. Our price didn’t contain PC.

2.Technical details

determine the thermal conductivity λ in building materials thermal conductivity λ and thermal resistance measurement 8 samples to be inserted between hot and cold plate hot plate with heating mat
cold plate with water cooling and heat flux sensor software controller for temperature adjustment of cold and hot plate 3 temperature sensors for cooling water: at the inlet, outlet and centre of the plate
2 temperature sensors for the surface temperature of the hot and cold plate software for data acquisition via USB under Windows 7, 8.1, 10
Technical data: Electric heating mat, output: 500W, max. temperature: 80°C
Samples LxW: 300x300mm thickness: up to max. 50mm material: Armaflex, chipboard, PMMA, styrofoam,

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SR-WL900 Steady-State and Non-Steady-State Heat Conduction

1.Description: Heat conduction is the transport of heat between the individual molecules in solid, liquid and gaseous media under the influence of a temperature difference. Steady heat conduction is the term used when heat transport is maintained permanently and uniformly by adding heat. In transient heat conduction, the temperature distribution in the body is dependent on location and time.

Thermal conductivity λ is a temperature-dependent property of a material that indicates how well the heat propagates from a point in the material. It can be used to study both steady and transient heat conduction. The trainer consists of a heat source and a heat sink, between which cylindrical samples made of different metals are inserted. Each sample is fitted with 12 temperature measurement points. The temperature measurement points are designed to has as little influence on the temperature as possible and the core temperature of the sample is measured. The heat source consists of an electrically heated hot water circuit. An electronic controller ensures the heating water is kept at a constant temperature. The heat sink is realised by means of a water cooling system. An elevated tank ensures a constant cooling water flow rate. A temperature jump can be generated by appropriate regulation of the cooling water flow. A PC can be used to display the transient temperature distribution in the sample over time and place. The temperatures of the sample, heating and cooling water, as well as the electrical heating power and the cooling water flow rate are displayed digitally on the switch cabinet and can be transmitted simultaneously via USB directly to a PC where they can be analysed using the software included. The thermal conductivity λ can be calculated from the measured data.

2.Technical details

investigation of steady and transient heat conduction in metals determining the thermal conductivity λ heating water circuit as heat source, electronically regulated electric heater with PID controller elevated tank with overflow for generating a constant cooling water flow rate samples made of 5 different metals cooling water temperature and flow rate measurement digital displays: electric heating power, temperatures, cooling water flow rate software for data acquisition via USB under Windows 7, 8.1, 10 Technical data: Heater output: 800W temperature: 20…85°C Samples, Ø 40mm 3x 450mm (copper, aluminium, brass) 2x 300mm (steel, stainless steel) Heating tank: ca. 2L Cooling tank: ca. 0,5L Elevated tank: ca. 6L Temperature sensors 12x thermocouple type K, along the sample 2x Pt100, in the cooling water 1x Pt100, in the heating water Measuring ranges temperature: 14x 0…100°C power: 0…1000W flow rate: 0,1…2,5L/min 230V, 50Hz, 1 phase 230V, 60Hz, 1 phase, 120V, 60Hz, 1 phase

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SR3027 Heat Conduction in Metals

1.Specification

[1] investigation of the thermal conductivity of different metals, [2] continuously adjustable heater, [3] Peltier element as cooler, [4] 11 samples made of 5 metals, different lengths, [6] due to integrated microprocessor-based instrumentation no additional devices with error-prone wiring are required

The unit shall perform the following experiments and investigations:

Learning Objectives / Experiments

time dependency u

metals calculate the thermal resistance of the sample heat transfer with different samples connected in series effect of sample length on heat transfer

2.Technical Data

Peltier element,cooling capacity 56, 6W Heater, heating power 30W,temperature limitation: 150°C Samples Ø 20mm, Length between measuring points, 5x 20mm (copper, steel, stainless steel, brass, aluminium), 5x 40mm (copper, steel, stainless steel, brass, aluminium), 1x 40mm with turned groove (aluminium), Measuring ranges,temperature: 4x 0...325°C, heating power: 0...50W, Dimensions and Weight LxWxH: 670x350x480mm Weight: approx. 18kg, Material of construction: stainless steel

SR3028 Heat Conduction in Fluids

The unit shall perform the following experiments and investigations:

Learning Objectives / Experiments, steady heat conduction in gases and liquids:determine the thermal resistance of fluids, determination of thermal conductivities k for different fluids at different temperatures transient heat conduction in fluids:interpret transient states during heating and cooling introduction to transient heat conduction with the block capacity model

Specification

[1] investigation of the thermal conductivity of common fluids, e.g. water, oil, air or carbon dioxide [2] concentric annular gap between 2 cylinders containing the fluid being studied, [3] inner cylinder, continuously electrically heated, [4] water-cooled outer cylinder, [6] due to integrated microprocessor-based instrumentation no additional devices with error-prone wiring are required, heating power: 350W temperature limitation: 95°C Heat transfer area: 0,007439m² Annular gap, height: 0,4mm,average diameter: 29, 6mm Inner cylinder,mass: 0, 11kg,specific heat capacity: 890J/kg-K Measuring ranges temperature: 2x 0...325°C heating power: 0...450W, Dimensions and Weight, LxWxH: 670x350x480mm Weight: approx. 18kg, Material of construction: stainless steel

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SR3029 Heat Conduction and Convection

1.Learning Objectives / Experiments

effect of heat conduction and convection on heat transfer, effect of free and forced convection on heat transfer, calculate convective heat transfers, effect of different materials on heat conduction, effect of sample length on heat transfer

2.Specification

[1] investigate heat conduction and convection using the example of a cooling fin, [2] cooling fin: sample heated at one end, made of metal, [3] 6 samples made of different materials and with different lengths [4] 6 fans for experiments with forced convection, [5] continuously adjustable heating power and fan power, [7] due to integrated microprocessor-based instrumentation no additional devices with error-prone wiring are required

3.Technical Data

Heater, heating power: 30W, temperature limitation: 160°C 6x fan, max. flow rate: 40m³/h, nominal speed: 14400rpm, power consumption: 7,9W 4x samples, short, length dissipating heat: 104mm, heat transfer area: 32,6cm², copper, aluminium, brass, steel 2x samples, long, length dissipating heat: 154mm, heat transfer area: 48,4cm², copper, steel Measuring ranges, flow velocity: 0...10m/s, temperature: 8x 0...325°C, heating power: 0...30W

SR3126 Natural and forced convection study bench

The bench should allow:

The study of the natural and forced convection for different forms (minimum two forms). The comparison between the two convection modes.

Variable air flow, Variable heating power, Measurement and display of the temperature, the heating power and the air flow speed. Power supply: 220V/380V/50Hz.

The experiment content:

The characteristics of temperature change under natural convection in heating body.

The characteristics of temperature change under forced convection.

Comparison of heat dissipation efficiency of two convective modes.

The equipment is marked with the European conformity CE or equivalent and a certificate of conformity is delivered.

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SL362 Energy transfer by radiation

1. Description

Thermal radiation is a non-material-bound energy transport by means of electromagnetic oscillations in a certain wavelength range. Any body with a temperature above zero Kelvin emits radiation known as thermal radiation. Thermal radiation includes UV radiation, light radiation and infrared radiation. Radiation covers the wavelength range visible to the human eye.

The SL 362 experimental unit contains two radiation sources: a heat radiator and a light emitter. Thermal radiation is detected by means of a thermopile. Light radiation is recorded by means of a luxmeter with photodiode. Colours can be STup between the emitter and the detector. All components are mounted on an optical bench. The distance between the optical elements can be read from a scale along the optical bench.

2. Technical details

Thermal radiator and thermopile for the investigation of thermal radiation, Light source and luxmeter for the investigation of illuminance, Absorption plate and reflection plate with thermocouples for the investigation of Kirchhoff's laws, Adjustable radiant power of thermal radiator and light source, 3 colour filters with holder (red, green, infrared), slit diaphragm, Luxmeter for measuring illuminance, Thermocouple for measuring the temperature, Thermopile for measuring radiant power

Technical data

Thermal radiator, Material: AlMg3, black anodized, Output: 400W at 230V, 340W at 120V, Max. achievable temperature: 300°C, Radiant area, LxW: 200x200mm,

Light source, Halogen lamp

Output: 42W, Luminous flux: 630lm, Colour temperature: 2900K,

Range of rotation on both sides: 0... 90°

Alternative illuminated surface, Diffusing lens, LxW: 193x193mm or, Orifice plate, Ø 25mm, Optical elements to insert, Slit diaphragm, 3 colour filters: red, green, infrared, Absorption plate and reflection plate with thermocouple type K, matt black lacquered, Measuring ranges, Illuminance: 0...1000 lux

Temperature: 2x 0...200°C,

Radiant power: 0...1000W/m2, 230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase, UL/CSA optional, Required for operation, PC with Windows recommended

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SL220 Boiling process

1. Description

Heating, a limitation of the heat flux density must be assured In order to prevent damage to the heating surface. This knoSLedge is applied in practice eg when designing steam boilers for steam-powered drives.The volt 220 experimental unit can be used to demonstrate boiling and evaporation processes in a straightforward manner. The processes take place in a transparent tank. A condenser in the form of a water-cooled tube coil ensures a closed circuit within the tank.

Rap3.com is used as evaporating liquid.

Sensors record the flow rate of the cooling water, the heating power, pressure and temperatures at all relevant points.

2. Technical details

Visualisation of boiling and evaporation in a transparent pressure vessel, Evaporation with heating element, Condensation with tube coil, Safety valve protects against overpressure in the system, Pressure switch for additional protection of the pressure vessel, adjustable, Sensors for pressure, flow rate and temperature with digital display, Refrigerant R1233zd, GWP: 1

Heater, Power: 250W, continuous adjustable, Safety valve: 2bar rel, Pressure vessel: 2850mL

Condenser: coiled tube made of copper, Refrigerant R1233zd, GWP: 1, Filling volume: 1,2kg

CO2-equivalent: 0t, Measuring ranges, Pressure: 0...4bar abs. (tank), Power: 0...300W (heater)

Flow rate: 0,05...1,8L/min (cooling water), Temperature: 4x 0...100°C, 230V, 50Hz, 1 phase/230V, 60Hz, 1 phase/120V, 60Hz, 1 phase UL/CSA optional

ZM8211 Stefan Botzman Apparatus

I. Overview

The device is designed to determine the Boltzmann constant

The device consists of a hemisphere fixed on a rubber board. The outer surface and the inner wall form a cavity. The hot water tank is fixed above the hemisphere, and the hot water of the heated hemisphere is obtained from the hot water tank. A copper test disk is placed in the center of the hemisphere, and the temperature of the hemisphere and the test disk is measured with the help of a temperature sensor.

II.The purpose of the experiment:

Determine the Boltman constant

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SL230 Condensation process

1. Description

Condensation forms when steam meets a medium with a lower temperature than the saturation temperature for the existing partial pressure of the steam. Factors such as the material and surface roughness of the medium influence the heat transfer and thus the type of condensation. Is usually film condensation.

KnoSLedge of condensation processes is applied eg steam power plants or at distillation processes. The SL 230 experimental unit can be used to demonstrate the different condensation processes using two tubular shaped water-cooled condensers made of different materials. Dropwise condensation can be by means of the condenser with a polished gold-plated surface. Film condensation forms on the Matt copper surface of the second condenser, thus making it possible to examine film condensation.
The tank can be evacuated via a water jet pump. The boiling point and the pressure in the system are varied by cooling and heating power. Sensors record the temperature, pressure and flow rate at all relevant points.

2. Technical details

Visualisation of the condensation process of water in a transparent tank, Two water-cooled tubes as condensers with different surfaces to realise film condensation and controlled heater to adjust the boiling temperature, Water jet pump to evacuate the tank, Pressure switch and safety valve for safe operation Sensors for temperature, pressure and flow rate with digital display

SL310 Cross-Flow Heat Exchanger

Technical Description

The experimental unit mainly includes a vertical air Duct. A fan draws the air through the duct. Interchangeable heaters dissipate heat directly into the Airflow. The following heater elements are included: Pipe, pipe bundle and finned pipe. To investigate the Effect of the flow in the pipe bundle, the heater insert Can be positioned in different pipe rows.Electronic sensors are used to take measurements. The measured values are indicated digitally on the Learning Objectives / Experiments

Clear experimental set-up for demonstrating the Fundamental principles of heat transfer1
Processing of measured data on a PC1, investigation of convection processes, comparison of heat transfer for different heating elements, comparison between different heating elements, monstration of the relationship between heat, ansfer, area of heat transfer and flow velocity (Nusselt)

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SL204 Vapour pressure of water MarcSTboiler

1. Description

In a closed system filled with fluid, a thermodynamic equilibrium sets in between the fluid and its vaporised phase. The prevailing pressure is called vapour pressure. It is substance-specific and temperature-dependent. When a fluid is heated in a closed tank, the pressure increases as the temperature rises. Theoretically, the pressure increase is possible up to the critical point at which the densities of the fluid and gaseous phases are equal. Fluid and vapour are then no longer Distinguishable from each other. This knoSLedge is applied in practice in process technology for freeze drying or pressure cooking. It can be used to demonstrate the relationship between the pressure and temperature of water in a straightforward manner. Temperatures of up to 200°C are possible for recording the vapour pressure curve. The temperature and pressure can be continuously monitored via a Digital temperature display and a Bourdon tube pressure gauge. A temperature limiter and pressure relief valve are fitted as safety devices and protect the system against overpressure.

Measuring a vapour pressure curve for saturated vapour, Pressure boiler with insulating jacket, Temperature limiter and safety valve protect against overpressure in the system, Bourdon tube pressure gauge to indicate pressure, Digital temperature display. Bourdon tube pressure gauge: -1...24bar, Temperature limiter: 200°C, Safety valve: 20bar, Heater: 2kW. Boiler, stainless steel: 2L, Measuring ranges, Temperature: 0...200°C, Pressure: 0...20bar

ZM8210 Emissivity Measurement Apparatus

The emissivity of the surface of various materials is a physical quantity that characterizes the surface radiation properties of a substance and is an important thermophysical parameter. The device is used to test the emissivity of aluminum plates, and is equipped with temperature and pressure sensors to test the effect of emissivity under different pressures. The main structure uses aluminum alloy frame and wood board. Equipped with temperature and pressure sensors to view data directly through the panel. Equipped with a compressor for pressure and vacuum experiments

Dimensions: 1000mm*750mm*530mm, compressor parameters: AC 220V 50Hz 250W, rating temperature range: ≤100°C, pressure range: -0.08MPa~+0.2MPa, chine quality: ≤30kg

3. Product composition: Experimental panel, pressure laboratory, compressor

4. Completed training projects: test board emissivity measurement, convection temperature detection

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Thermal Dynamic Lab Equipment 2-Applied Thermal Dynamics

ZF1115A Trainer for Various Heat Exchangers

Specification

[1] examination and comparison of various heat exchanger types [2] five different types of heat exchangers included in the scope of delivery, [3] finned heat exchanger with fan, [4] operating mode (parallel flow or counter flow) selectable via valves, [5] flow rates adjustable via valves, [6] electromagnetic flow meter, [6] electromagnetic flow meter, [7] digital displays for temperature, pressure differences and flow rate, [8] hot & cold water benches available for independent operation, [9] water/steam heat exchanger unit and electrical steam, Generator available for further experiments

Plate heat exchanger, 10 plates, heat transfer surface area: approx. 0,26m², capacity: 15kW, Tubular heat exchanger, heat transfer surface area: 0,1m², heat transfer surface area (coil): 0,17m², Shell and tube heat exchanger, capacity: 13kW, Finned cross-flow heat exchanger, heat transfer surface area: approx. 2,8m², max. flow rate fan: 780m³/h, max. pressure difference fan: 430Pa, Jacketed vessel with stirrer, heat transfer surface area (vessel): 0,16m², heat transfer surface area (coil): 0,17m², Measuring ranges, differential pressure air: 0...10mbar, differential pressure water: 0...1000mbar, flow rate: 0...3m³/h temperature: 0...100°C, Dimensions and Weight, LxWxH: 2010x800x1760mm, Weight: approx. 300kg

SR-WL302 Concentric Heat Exchanger

The Concentric Heat Exchanger should investigate the fundamental principles of heat transfer as applied to a liquid-to-liquid heat exchanger. A simple arrangement of valves allows operation as either a parallel flow or counter-flow heat exchanger enabling temperature profiles, energy balances, heat transfer coefficients and log mean temperature differences to be obtained for both conditions.

The apparatus should required only a cold water supply, single phase electrical outlet and a bench top to enable a series of simple measurements to be made by students needing an introduction to heat exchanger design and operation. Experiments can be readily conducted in a short period of time,

operation. Experiments can be readily conducted in a short period of time, without the need of setting up operations, to accurately show the practical importance of the followings: a) Temperature profiles, b) Coand counter-current flow, c) Energy balances, d) Log mean temperature difference, e) Heat transfer coefficients. The equipment Should consists of a concentric tube exchanger in the form of “U”, mounted

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on a support frame. The external surface of the exchanger is insulated. Six temperature sensors are installed in both the inlet and outlet tubes, to measure the fluid temperatures accurately. To minimise losses in the system, the hot water is fed through the inner pipe, with the cooling water in the outer annulus. Control valves are incorporated in each of the two streams to regulate the flow. The flow rates are measured using independent flow meters installed in each line. Temperature and flow readings could continuously being, captured and logged into the computer with optional Data Acquisition System. These data are useful for further calculations and analysis. On-line trending display allows student to observe the fluctuations of flow and temperature readings immediately.

The hot water system is totally self-contained. A hot water storage tank is equipped with an immersion type heater and a temperature controller. Circulation to the heat exchanger is provided by a pump, and water returns to the storage tank via a baffle arrangement to ensure adequate mixing. The cold water required for the exchanger is taken from the laboratory mains supply. A readily identifiable valve arrangement allows simple change-over between co and counter-current configurations.

ST300 Finned tube heat exchanger water/air

Tubular heat exchangers are often used for heating or cooling gaseous media, such as air coolers for internal combustion engines. Hot water flows in the tubes, which are surrounded by a flowing gaseous medium, eg cold air. The hot medium emits some of its thermal Energy to the cold medium.

The tubes are fitted with fins to increase the heat transfer surface and thus improve the convective heat transfer. It is used for quantitative investigations on a finned-tube heat exchanger using the media hot water and cold air.

The core element of the trainer is an air duct with fan, in which a finned-tube heat exchanger is installed. The trainer has a closed hot water circuit consisting of: water tank with heater, pump, adjustable flow rate, electromagnetic flow rate sensor and finned-tube heat exchanger. The flow rate can be adjusted via a valve. In addition, a pressure sensor in the water circuit makes it possible to plot a pump characteristic. Finned-tube heat exchanger to study convective heat transfer between water and air, Function of the heat exchanger as an air heater or water cooler, Closed hot water circuit with electric heater, thermostat, water tank and pump, Adjustable water and air flow, Determination of the air volumetric flow rate by differential pressure at Digital display of temperatures, flow rates and pressure, Technical data, Finned-tube heat exchanger, Material: Cu/Al, Average transfer surface: 2,80m2 (air side), Output: 2kW, Water temperature: 70°C, Pump, Power consumption: 470W, Max. flow rate: 4,2m3/h, Max. head: 20,5m, Fan Power consumption: 0,25kW, Max. flow rate: 13m3/min, Max. pressure difference: 430Pa, Water tank: 28L, Heater: 2kW, Thermostat: max. 80°C, Measuring ranges, Temperature: 4x 0...100°C, Flow rate: water 0...6m3/h, Pressure: water 0...4bar abs., Mass flow rate: air 0...250g/s, 230V, 50Hz, 1 phase/230V, 60Hz, 1 phase; 230V, 60Hz, 3 phases

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ZM8209 Forced Convection Apparatus

The forced convection heat transfer device allows the student to examine the theory and related formulas related to forced convection in the tube. The equipment has a fan, a test tube and an instrument panel. The test panel is equipped with control switches and meters to facilitate the measurement and calculation of test data. The fan operates at a constant speed and controls the air flow rate through a control valve. The air then enters the U-shaped pipe, as well as the copper test pipe.

Provide the airflow necessary for forced convection for the experiment.

The bottom of the experimental device is equipped with two brake universal wheels and two brake wheels without brakes. Easy to move and fixed. The aluminum profile frame reduces weight while making it more aesthetically pleasing. The training device is suitable for the teaching and skill training assessment of higher vocational colleges, junior colleges, secondary vocational schools and technical schools.

1-2 features

1. This training device is developed for forced convection in practical applications. Various sensors are used to facilitate students to observe experimental phenomena and summarize experimental data.

2, using standardized modular design, the test pipeline is made of copper tube, the experimental effect is more obvious. 3. Each component power cable and signal cable are connected to the board through wires, which is safe and convenient.

II.The performance parameters

(1) Dimensions: 1100mm × 600mm × 1300mm, (2) Weight: <150kg, (3) Working conditions: ambient temperature -10 °C ~ +40 °C Relative humidity <85% (25 °C), (4) Working voltage: three-phase four-wire AC 380V, (5) Machine power: <1000W

III. An complete the experiment

Forced convection heat transfer test

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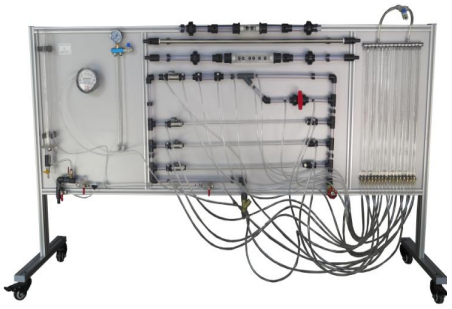
Thermal Engineering Lab 3- For Construction

ZF1116A Thermal Expansion Trainer Panel

Training panel for investigating the thermal expansion of different pipe, sections, Length of each pipe section 1200mm, Pipe sections can be selected by ball valves, Water connections made using quick action hose couplings

Operation with hot and cold water supplies , Adjustment of the water, temperature using mixing battery with thermocouple, Temperature measurement using batteryoperated digital thermometer, Force measuring device to determine the expansion force, Pipe section length: 1000mm, Nominal diameters: PVC, PE, Cu: DN15 Cu: DN8 Steel: 1/2" , Mixing battery connection: 1/2", Force measuring device: spring rate per spring: 78N/mm total spring rate c: 156N/mm

ZF1117A Pipe Friction Training Panel



[1] investigation of the pipe friction in laminar or turbulent flow on Hydraulic Bench, [2] transparent tank with overflow ensures constant water inlet pressure in the pipe section for experiments with laminar flow, [3] water supply via Base Module (Hydraulic Bench) or via laboratory supply for experiments with turbulent flow[4] flow rate adjustment via valves [5] twin tube manometer for measurements in laminar flow [6] dialgauge manometer for measurements in turbulent flow, [7] via laboratory supply

Diameter of test pipe : 3.0mm (Bore) Length of test pipe : 524mm, Needle Valve included to regulate flow rate, length: 1000mm Pipe section 1: acrylic 20x1.5mm Pipe section 2: steel 1/2" , Smoothbore pipes of various diameters Size 6mm , 10mm, 17mm , Overall dimensions:, Height : 1.05m form the ground level , Width : 2.25m, Depth : 0.43m, Test Pipe Diameters: The Pipe network should have 90° Bends, 90° elbow,90°T, 45°elbow & Y. Sudden enlargement, Sudden contraction, Ball Valve, Gate Valve Globe valve, Inline strainer, Venturi made of clear acrylic , orifice palte made of clear acrylic, Pitot Static tube section made of clear acrylic

EXPERIMENTAL CAPABILITIES

Laminar to turbulent flow regimes in pipes, Energy losses in pipe fittings and bends, Flow measurement using venturi meter, Flow measurement using orifice plate, Use of pitot static tube, Use of manometers

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ZF1118A Radiator Training Panel

Description

The panel contains a pipe system with four radiators. Each radiator has an air bleed, a thermostatic valve and lockshield valve. Rotameters indicate the flow rate through each individual radiator and for the entire system. Connections for cooling water make it possible to dissipate the heat supplied by the hot water. All water connections are made using quickrelease couplings. Training panel on heating systems and plumbing. 4 radiators with thermostatic valve, air bleed and adjustable lock shield valve.

Water connections made using quick action hose couplings, Hot and cold water supply, Rota meters: 1x 1000ltr/h 4x 300ltr/h, Radiator: plate heat exchanger with 10 plates, capacity: 3kW

SR1162E Heat Transfer Bench

A complete floor standing unit, Specially designed to help student understand the characteristics of a cross flow heat transfer. The unit consists mainly of a vertical duct with clear window, heat transfer elements, a constant speed fan with iris damper, and all the necessary sensors to measure temperatures at various points and air velocity

[1] convective heat transfer, [2] exchangeable pipe bundle as heat exchanger, [3] 2 heaters can be inserted in a bundle or alone

[4] air flow rate adjustable, [5] Digital Display for pressure measurement station

measurement station to determine air velocity, [6] display and control unit indicates air temperature, heater temperature and heating power

Description:

The unit should have three heat transfer elements as follow: a. Single tube b. Tube bundle c. Finned surface. The surface incorporates an electrical heating element with temperature sensor.

Duct, Vertical rectangular epoxy coated mild steel duct mountes on floor standing wheeled frame.

Acrylic window on the wall of the duct, crosssection: W xD x H 0.8 x 0.17 x 1.08 m

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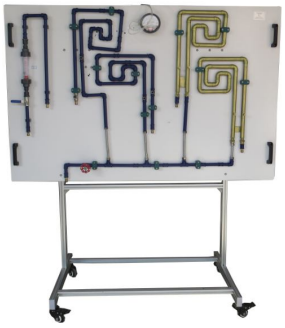
ZF1119A Fitting Loss Training Panel



Training panel for investigating the pressure losses in pipe fittings such as elbows and bends. 4different measuring sections, measured length of each section 2300mm, 10 elbows/bends. Pressure measurement with annular chambers with electronic differential pressure gauge. Flow rate measurement with Rota meter. Hose connections made using quick action coupling. Water feed via pressure reducer, Cold water connection, Differential pressure gauge with bleed, measuring range: 0...2000mbar supply: 9V, batteryoperated, Rota meter: measuring range 150...1600ltr/h, Outlet pressure at pressure reducer: 0.5...2bar, Pipe sections: measured length: 2300mm Pipe section 1: steel, bend, 1/2", 90° bend Pipe section 3: copper 18x1mm, 90° elbow Pipe section 4: copper 18x1mm, 90° bend, Pipe and Fittings, 7mm bore test section, 13.6mm bore test section, 13.6mm bore test section with four bends, 13.6mm bore test section with four elbows, 13.6mm bore test section with ball valve, 13.6mm bore test section with angle seated valve

Expeirmental Capabilities

Determination of pressure drop across various pipes and fittings at differnet flow rates

Flow rate/diameter relationship determination for flid flow in pipes

Estimation of loss coefficient (K) for various pipes, pipe fitting and valve settings

Friction Factor determination for fluid flow in smooth pipes

ZF1120A Valves Loss Training Panel

Training panel on heating systems and plumbing,
1 transparent PVC ball valve, 1 galvanized brass ball valve,
1 y type globe valve,1 plug valve, 1 gate valve, Pipe sections can be individually selected using ball valves, digital differential pressure gauge, differential pressure gauge, Water connections made using rapid action hose couplings, Water supply 1500ltr/h, Digital differential pressure gauge: measuring range: 0..1000mbar supply: 9V batter, Flow rate measuring range: 150...1600ltr/h, Transparent PVC ball valve: DN32, Galvanized brass ball valve: DN15

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ZF1121A Temperature Measurement Training Panel

Training panel for experiments on temperature measurement Investigation of 4 different temperature measuring techniques in the range from 0...60°C, 4 different measuring sections, can be selected individually with ball valves. Digital display of the temperatures measured using the electronic sensors. Flow rate measurement with Rota meter. Water connections using quick action hose couplings, Hot water connection required, Measuring ranges of thermometer Bimetallic dial thermometer: 0...80°C

Liquid expansion thermometer: 0...80°C Resistance thermometer, PT100:50...400°C Thermocouple type K: 0..1200°C, Heating Tank Capacity 25 Lts, Power 220V/50 Hz, Dimension 1850 X 240 X 1200mm

ZF1122A Safety Devices Training Panel

The Pressure Gauge Calibration Bench is a complete laboratory bench for test and calibration of various elements of pressure readings applied for industry. The unit is also an excellent test bench for all other disciplines, which involve measuring and generating pressure. The measuring unit comprises the following main components: a) Bellow pressure gauge
b) Membrane pressure gauge, c) Bourdon pressure gauge, d) Digital pressure calibrator, e) Pressure regulator, f) Pressure release valve

Experiment list

Pressure measurement comparison by Digital, manometer and Bourdon gauges.
Error determination for gauges. Pressure gauges calibration. Bellows Pressure Gauge: Pressure range : 0 to 600 mbar Accuracy : Class 1.6, Gauge diameter : 100 mm, Membrane Pressure Gauge: Pressure range : 0 to 1.6 bar, Accuracy : Class 1.6, Gauge diameter : 100 mm, Bourdon Pressure Gauge: Pressure range : 0 to 2.5 bar, Accuracy : Class 1.6, Gauge diameter : 100 mm, Digital Pressure Calibrator: Pressure range : 0 to 7 bar, Accuracy : <0.2%, Display : LCD 4 digits (back lit), Resolution : 1 m bar, Units : bar/k Pa/psi/mmH2O, Pressure Regulator: Pressure range : 3 to 20 psi, Release Valve: Pressure range : 0 to 3.5 bar (max.), Protected against excessive Pressure

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ZF1122B Central Geo Thermal Heating System

Function and operating behaviors of a modern heating system with digital heating controller, Fourway mixer and threeway mixer, Electric boiler, 2 circulating pumps, 1 domestic water pump, 4 different radiators and additional plate heat exchanger with shower system as domestic water consumer, Colored pipes indicate heating feed and return, Colored pipes indicate heating feed and return, Measurement of temperature, pressure and flow rate, Boiler, 4 stages: 6/9/12/15kW, Max. Feed temperature: 95°C, Water tank capacity: 16 ltr

Circulating pump 3 stages: 60W, Max. Flow rate: 60ltr/min, Max. Head: 4m, Domestic water pump: 20W, max. 640ltr/h, max. 0.14bar, Plate heat exchanger: 3kW, 10 plates, Measuring ranges: temperature: 3x 20...120°C / 2x 0...120°C / 2x 0...100°C / 4x 0...80°C, pressure: 8x 0...2.5bar, flow rate: 100...1000ltr/h, water meter: 2.5m³/h, Manual with theory and experiments,
Size(LxWxH): 1500x900x1700mm, Weight: 300Kg,

Technical data

a. Heat pump system, b. Compressor : 1HP, c. Condenser : Aircooled type, d. Evaporator: pin, Tube aircooled type, e. Evaporator, f. Expansion Valve : manual type, g. Liquid receiver : 1/2HP, h. Accumulator : 1HP, i. Electronic valve : 3/8" nut clamp type, j. Manometer, k. Fitting nipple, l. Sight Glass m. Electric control module: DC24V, n. Thermostat range:50℃~100℃, o. Geothermal system, Ground unit chamber, Water unit chamber

SR3001 Supply Bench for training panel

Supply bench for the training panel, Mobile support made of welded square tube, powder coated, Locked cabinet, Drip tray made of glass fiber reinforced plastic, Inputs: cold and hot water, gas, mains power and high voltage supplies

Output: 2*220V, 2*400V, 1 gas outlet with gas connector, 1* hot water, 1* cold water, heating feed and return, Output 2*220V, 50Hz, 1 phase 1*400V, 50Hz, 3 phase, 16A, 1*400V, 50Hz, 3 phase, 32A, Gas connection, with gas connector

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SR3006 Four way mixing valve training panel

Learning Objectives / Experiments

Function and operating behaviour of a fourway mixing valve, Effect of the mixing ratio on feed and circulating flow temperature, Effect of mixer setting on the flow rate, In conjunction with other trainers, it is possible to setup a complete heating system.

Specification

[1] Trainer on heating systems and plumbing, [2] 4way mixing valve, [3] Circulating pump, [4] 4 rotameters, [5] 4 bimetallic dial thermometers, [6] 2 heating water connections, [7] 2 water connections for boiler, [8] 1 differential pressure overflow valve, [9] Water connections made using quickrelease couplings, Pump power consumption: 60W max. flow rate: 60L/min max. head: 4m, Fourway mixing valve setting angle: 90° opening time: 2min, Measuring ranges flow rate: 3x 150...1600L/h, 1x 0...440L/h temperature: 0...100°C, Dimensions and Weight l x w x h: 1650 x 200 x 1100 mm (panel) Weight: approx. 45 kg (panel), Connections, 230V, 50Hz, 1 phase, Hot water supply: 1500L/h, drain

SR3007 Expansion vessel training panel

Learning Objectives / Experiments

Function and operation of a diaphragm expansion vessel

Displacement volume of an expansion vessel as a function of the pressure

Specification

[1] Trainer on heating systems and plumbing, [2] Small compressor for pressure generation, [3] Measuring tank with scale, [4] Expansion vessel [5] Manometer, [6] Ball valve in connecting pipe between measuring tank and expansion vessel [7] Adjustable safety valve, [8] Pressure controller for air with overpressure protection, [9] Cutaway model of an expansion vessel

Technical Data

Expansion vessel volume: 2L filling pressure: 0.5bar, Measuring tank volume: 3.75 max. pressure: 2.5bar Compressor, power consumption: 65W, max. flow rate: 11.5L/min max. pressure: 2bar final vacuum: 240mbar, Pressure controller for air, adjustable: 0.06...2bar,

Measuring range pressure: 0...2.5bar

Dimensions l x w x h: 1650 x 280 x 1100 mm (panel)

Weight: approx. 50 kg (panel)

Connections: 230V, 50Hz, 1 phase

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SR3008 Radiator training panel

Contained components

[1] Trainer on heating systems and plumbing,

[2] 4 radiators with thermostatic valve, air bleed and adjustable lockshield valve,

[3] 2 water connections for boiler

[4] 2 cooling water connections

[5] Water connections made using quick release couplings

Learning Objectives / Experiments

Hydronic balancing of radiators, Determination of the heat emitted, Determination of pipework characteristics for different operating conditions. In conjunction with other training panels, it is possible to setup a complete heating system.

Technical Data

Radiator, plate heat exchanger with 10 plates, capacity: 3kW, Measuring ranges,flow rate: 1x 0...1000L/h, 4x 0...300L/h, Dimensions and Weight, l x w x h: 1650 x 350 x 1100 mm, Weight: approx. 60 kg (panel)

SR3009 Hydronic balancing of radiators

Specification

[1] trainer for heating and plumbing,

[2] 6 radiators with thermostatic valve, bleed valve and adjustable lockshield valve,

[3] expansion vessel, safety group, overflow valve,

[4] 1 surface thermometer for temperature measurement at radiator inlets and outlets

[5] water connections using quick release couplings,

variable pipework resistance, balancing valve, preset thermostatic valve, differential pressure relief valve, diameter inside 13mm, for optional connection to an external heating circuit

Technical Data

Pump, power consumption: 60W, max. flow rate: 60L/min, max. head: 4m, 6 balancing valves: PN 16
Measuring ranges, flow rate: 1x 30...320L/h, 4x 50...640L/h, temperature: 1x50...300°C,
Dimensions Weight LxWxH: 2.250x750x1.790mm,
Weight: approx. 210kg, Required for Operation, 230V, 50Hz, 1 phase

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SR3010 Hydronic balancing of radiators

familiarisation with a heating circuit, familiarisation with temperature control two point controller PID controller, recording of step response, recording of fitting and pump characteristics energy balances, determining pump efficiency from hydraulic power and electrical power consumption, heat transfer with convector (watertoair heat exchanger with fan), comparison of circulating pumps conventional pump, differential pressure controlled pump

Specification

[1] fundamentals of energy efficient heating technology, [2] closed water circuit with 2 circulating pumps, expansion vessel, heater and convector, [4] boiler safety group according, [5] 7 differential pressure sensors, 4 temperature sensors, 1 effective power sensor and 1 flow rate sensor

Technical Data

Conventional circulating pump, 3 stages, power consumption: 43...80W, max. flow rate: 3,7m³/h max. head: 6,2m, Differential pressurecontrolled circulating pump, power consumption: 4...50W, max. flow rate: 3,5m³/h max. head: 6m, Electric heater: 2.000W, Expansion vessel: 2L, adjustable reference variable: 0...80°C, Measuring ranges, differential pressure: 5x 0...600mbar, 2x 0...100mbar,temperature: 0...100°C flow rate: 1...50L/min, effective power: 0...200W, Dimensions and Weight, LxWxH: 2.000x750x1.760mm Weight: approx. 150kg, Required for Operation 230V, 50Hz, 1 phase

SR3011 Domestic Gas Supply Training Panel

Learning Objectives / Experiments

Simulation of different leaks, Demonstration of leak detection Working on gas pipes, Testing before and after gas connection in accordance with regulations

Specification

[1] Exercises on gas pipes, [2] 2 individually selectable pipe sections, [3] 1 gas meter with 1 connection, [4] 1 gas meter with 2 connections, [5] 1 pipe section for finding leaks, [6] 1 pipe section as supply pipe with gas socket and gas connection with ball valve

Technical Data

Air pressure controller, max. inlet pressure: 21bar, outlet pressure: 0.01...0.6bar, Gas pressure controller admission pressure: 350mbar, outlet pressure: 20mbar, Leak testing device: max. 500mmWC, Dimensions and Weight, l x w x h: 1650 x 200 x 1100 mm (panel), Weight: approx. 50 kg (panel), Connections, Compressed air supply

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SR3013 training panel function of gas heater

Learning Objectives / Experiments

familiarisation with the functioning of a combination boiler, understanding of a heating circuit, domestic water heating, measurement of gas pressures on a gas boiler, determination of power and efficiency

Specification

[1] familiarisation with a typical combination boiler, [2] main components clearly mounted on panel, [3] burner with viewing window for observation of flame [4] plate heat exchanger simulates radiator, cold water used as heating load, [5] additional, instrument for energy balances: thermometers, flow meters, manometers, [6] operation with propane gas

Technical Data: Gas boiler, nominal heating capacity range: 8.9...18kW, standard utilisation rate at nominal load: 93%, feed flow temperature: 82...87°C, hot water temperature: 30...65°C, permissible excess operating pressure, heater: 3bar

SR3014 Ventilation system

Learning Objectives / Experiments

design and operation of a ventilation system pressure measurements in the air duct, determine the electric drive power of the fan determine the flow rate design and operation of components such as protective grating, multileaf damper, filter, heat exchanger as air heater/cooler, fan, inspection cover, sound insulation link, ventilation grill with adjustable flow rate, fire protection flap,ceiling vents

Specification

[1] operation of a ventilation system, [2] all components from ventilation technology, some with sight windows, [3] protective grating and adjustable multileaf damper at the air inlet, [4] filter for air purification [5] heat exchanger to heat/cool the air, [6] beltdriven radial fan, [7] 2 sound insulation links [8] various air outlets for air distribution in the room: disc valve, ceiling vent and ventilation grill with adjustable flow rate, [9] inspection cover for inspection purposes, [10] fire protection flap prevents the crossover of fire and smoke in the air duct, [11] air duct with pressure measurement connections [12] pressure measurements with inclined tube manometer, [13] current measurement to determine the power consumption of the fan, [14] determine the flow rate via differential pressure

Technical Data: Air duct: 1845x630x305mm, Fan, max. flow rate: 2500m³/h, speed: 1600min1, drive motor: 750W**.** Airtowater heat exchanger as air heater/cooler, capacity: 7,6kW, Measuring ranges, pressure: 0...700Pa**,** current: 0...4A,

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SR3020 Circulating pump training panel

Learning Objectives / Experiments

Pump characteristics at varying speeds, Determination of pipework characteristics and operating points, Series operation of circulating pumps Parallel operation of circulating pumps,Comparison of experiment and calculation, In conjunction with other training panels it is possible to setup a complete heating, In conjunction with other training panels, it is possible to setup a complete heating System.

Specification

[1] Series and parallel operation of 2 pumps, [2] Training panel can be changed to various operating modes using ball valves, [3] 2 rotameters, [4] Pressure measurement with 6 Bourdon tube manometers [5] 1 bimetallic dial thermometer, [6] Water connections made using quickrelease couplings

Technical Data

2 pumps power consumption: 70W max. flow rate: 60L/min max. head: 4m, Measuring ranges flow rate 1x 150...1600L/h / 1x 400...4000L/h temperature: 0...60°C pressure: 0...2.5bar, Dimensions and Weight l x w x h: 1650 x 200 x 1100 mm (panel) Weight: approx. 58 kg (panel),Connections 230V, 50/60Hz, 1 phase or 120V, 60Hz, 1 phase

SR3021 Safety devices training panel

Specification: [1] trainer on heating systems and plumbing, [2] pressure vessel, [3] threaded heater element with switch cabinet, [4] 2 spring tube manometers, [5] 1 bimetallic dial thermometer, [6] thermal discharge safety device, [7] 1 system of safety devices with pressure reducing valve, shutoff valve, test connections and nonreturn valve, manometer connection and safety valve, [8] 2 blowoff lines, 1 filler pipe, 1 drain

Learning Objectives / Experiments

function of safety valves, function and layout of a system of safety devices

function of a thermal discharge safety device

Technical Data

Pressure vessel made of steel volume: approx. 5L max. operating pressure: 7,8bar, Threaded heater element power: 3kW protective system: IP 65, Thermal discharge safety device: actuated at 95°C Setting range of pressure reducing valve: 1,5...6bar, Measuring ranges, pressure: 0...10bar, temperature: 0...120°C, Required for Operation 230V, 50/60Hz, 1 phase Water connection, drain

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SR3023 Domestic heating system control training panel

Learning Objectives / Experiments

Operation of a heating controller,Temperature setting,Operating characteristics

Specification

[1] Trainer for digital heating control,

[2] Actual components: servo motor, room thermostat with temperature sensor, heating controller, [

3] 4 rotary potentiometers for adjustment of temperature setpoint,

[4] Simulation of: pumps, domestic water tank, radiator, 3way mixing valve and return valve; symbolically represented on panel

Technical Data

Servo motor for 3way mixing valve manual or automatic operation, Adjustable temperature setpoints, outdoor boiler outlet feed flow (heating circuit) domestic water, Digital heating controller controlled by atmospheric conditions, Measuring range temperature:20...60°C, Connections 230V, 50Hz, 1 phase

SR3025 Domestic heating boiler

Learning Objectives / Experiments: function of an oil burner, operation of a heating boiler with an oil burner, burner adjustment during operation, temperature measurements in different areas of the combustion chamber, calculation of the heating capacity of a heating boiler
function of a plate heat exchanger, temperature distributions in plate heat exchanger

Specification: [1] Functional heating boiler with oil burner, [2] Boiler with control unit, [3] Heating and cooling circuit equipped with expansion vessel, pump, boiler group, thermometers,

water meter, heat exchanger, [4] Transparent oil tank with filling and bleed connections, [5] Dissipation of generated heat via plate heat exchanger and cold water connection

Technical Data

Boiler, nominal rating: 17...21kW, control unit with temperature limiter, Burner, nominal power: approx. 18kW. Pump: power consumption: 70W, max. flow rate: 60L/min, max. head: 4m, Plate heat exchanger: 3kW, 10 plates, Boiler safety group in accordance 2.5bar, 50kW, Oil tank: 15L, Water meter: 2.5m³/h
Measuring ranges: temperature: 4x 0...120°C, 230V, 50/60Hz, 1 phase or 120V, 60Hz, 1 phase
Water connection, drain, Ventilation, exhaust gas routing required

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Thermal Engineering Lab 4- Dynamic Engine

SR2112 Two-Stage Compressor

Equipment composition: Aluminum profile frame structure, bottom with universal wheel, flexible movement. The two-stage piston compressor is fixed in the frame with three cylinders and a cooling water system.

Principle introduction: Compressed air for industry and businesses that use compressed air as an energy source is generated by means of so-called compressed air generation systems.

energy source is generated by means of so-called compressed air generation systems. A key component of these systems is the compressor. It converts the supplied mechanical energy into a higher air pressure.It converts the supplied mechanical energy into a higher air pressure. Compressed air generation systems are used to drive machines in mining, for pneumatic control systems in assembly plants or tyre inflation systems at petrol stations. The air is sucked into the intake vessel and calmed there before it is compressed in two stages. The additional pressure vessel for intercooling is located between the first and second stage. After the second stage, the compressed air is pressed into another pressure vessel through a cooling tube. To achieve a steady state, the compressed air can be released through a blow-off valve with silencer. Safety valves and a pressure switch complete the system. Sensors measure the pressures and temperatures in both stages as well as the electric power consumption. A nozzle at the intake vessel serves to determine the intake volumetric flow rate. The measured values can be read on digital displays.

Experimental contents: Thermodynamic experiments of two - stage compressors.The temperature pressure contrast of the first - and second-order compression.The bench allows the study of the thermodynamic aspects relative to the two-stage compressor. The bench is composed of: Alternative compressor. Two-stage piston compressor. Maximum pressure: 10 bars minimum. Air flow rate: from 100L/min.Reservoir capacity: 200L minimum. 2 air-water exchangers for the two stages, with possibility of choosing co-current or countercurrent exchange.

Measurement sensors: Flow rate sensor for measuring the cooling water flow rate.

Thermocouples for measuring air and water temperatures at different points.

Manometers for measuring the aspiration and the discharge pressures in each stage.

Air flow measurement sensor.

All the necessary accessories assuring the efficient functioning.

Power supply: 220V/380V/50Hz.

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ST513 Single-stage piston compressor

1. Description

The generation of compressed air for industrial and commercial purposes in areas where compressed air is used as a source of energy requires what are known as compressed air generation plants. A central part of these systems is the compressor. Of the air by means of mechanical energy. Compressed air generation plants are used to power machines in the mining industry, for pneumatic control systems in assembly facilities or as tyre inflation units at petrol stations. A measuring nozzle at the intake vessel is used to determine the suction volumetric flow rate.

Sensors record the pressures and temperatures in front of and behind the compressor. The pressure is also displayed on the manometers in the tanks..

2. Technical details

Investigation of a driven machine for compressed air generation

Single-stage piston compressor with one cylinder

Intake vessel with withdrawn nozzle for determination of the suction volumetric flow rate

Intake vessel and pressure vessel, both with pressure sensor and additional manometer

Safety valve and pressure switch with solenoid valve for limiting the pressure

Blow-off valve with silencer for setting a steady flow operating mode

Pressure and temperature sensors in front of and behind the compressor

Digital display for air flow rate, temperatures, pressures, differential pressures and compressor speed

Technical data

Compressor, 1 cylinder, single-stage, Power consumption: 750W,

Nominal speed: 980min-1, Positive operating pressure: 8bar,

Max. pressure: 10bar, Intake capacity: 150L/min at 8bar, Borehole: 65mm

Stroke: 46mm, Safety valve: 10bar, Pressure vessel, 16bar, Volume: 20L, Intake vessel: 20L

Measuring ranges, Temperature: 1x 0...200°C / 1x 0...100°C, Pressure: 0...16bar / -1...1bar,

Flow rate: 0...150L/min, Speed: 0...1000min-1,

230V, 50Hz, 1 phase/230V, 60Hz, 1 phase/120V, 60Hz, 1 phase

UL/CSA optional, Required for operation, PC with Windows recommended

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ST500 Two-stage piston compressor

1. Description

Compressed air for industry and businesses that use compressed air as energy source is generated by means of so-called compressed air generation systems. A key component of these systems is the compressor. It converts the supplied mechanical energy into a higher air pressure. Compressed Air generation systems are used to drive machines in mining, for pneumatic control systems in assembly plants or tyre inflation systems at petrol stations. ST500 includes a complete compressed air generation system with a two-stage compressor and an additional pressure vessel as intercooler. The trainer enables the recording of compressor characteristics and representing the compression process in a p-V diagram.

The air is sucked into the intake vessel through a pressurized nozzle and calmed there before it is compressed in two stages. The additional pressure vessel for intercooling is located between the first and second stage. After the second stage, the compressed air is pressed into another To be a steady state, the compressed air can be released through a blow-off valve with silencer. Safety valves and a pressure switch complete the system. The measured values can be read on digital displays. The measured values can be read on digital displays.

2. Technical details

The characteristic of a two-stage compressor, Piston compressor with 2 cylinders in V-arrangement Intake vessel with nozzle to measure the intake volumetric flow rate, pressure sensor and additional manometer, Pressure vessel after the first stage as intercooler

Pressure vessel after the second stage with safety valve, blow-off valve and silencer as well as an additional manometer and a pressure switch, Sensors for pressures, temperatures and electric power output, Digital displays for temperatures, pressures, differential pressures and electric power output

Compressor, Two-stage, With 2 cylinders in a V-arrangement, Power consumption: 3kW, Speed: 710min-1, Intake capacity: 250L/min, Quantity delivered: 202L/min (at 12bar)

Operating pressure: 12bar, max. 35bar, Intake vessel: 20L, Pressure vessels, 16bar; capacity:
After 1st stage: 5L, After 2nd stage: 20L

Safety valve: 16bar, Measuring ranges, Differential pressure: 0...25mbar, Pressure: 1x 0...1,5bar; 2x 0...16bar, Temperature: 4x 0...200°C

Power: 0...3500W, 400V, 50Hz, 3 phases/400V, 60Hz, 3 phases/230V, 60Hz, 3 phases, UL/CSA optional, Required for operation(price didn’t contain PC, you should buy in local), PC with Windows recommended

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Technology Know How

ZM9101 Liquid –Liquid Extraction Unit

Apparatus The apparatus consists of a liquid extraction glass column mounted on the side of the distillation column. This last column can be used to recover the solvent for extraction or to be used separately for the distillation process. This unit can develop and analyze the following topics: Extract. Determine the number of transfer units Height of the transfer unit. Extraction efficiency, Mass balance, Calculation of mass transfer coefficient, Calculate the number of theoretical stages, Concentration trends along the column, Practice on a system with 3 partially mixable components: Distillation Recover the solvent used in the extractionDistillation of different mixtures (water/ethanol, water/methanol, methanol/propanol, etc.) with changes in the following operating parameters: reflux ratio feed flow rate reboiler heating power feed composition, flood, Required technical characteristics: 5 stainless steel tanks with a capacity of 20 litres, Borosilicate glass extraction column, including 26 grades, h = 1500 mm, including stainless steel disc agitator, 2 borosilicate glass separators and variable speed motors (0 to 1000 rpm), 2 stainless steel metering pumps with flow rate 040 L / h, Borosilicate glass distillation column with vacuum jacket, Reflux head of borosilicate glass, Solenoid valve for controlling the return ratio, Stainless steel reboiler for distillation column with a capacity of 7 litres, Electric heater of stainless steel, P = 3000 W, Thyristor unit for controlling the electric heater, 2 timers for controlling the reflux ratio Overhead condenser of borosilicate glass with exchange surface of 0.3 m2, Flowmeter for the water feeding the head condenser, with range of 20 to 250 L/h, 3 thermoresistances Pt 100 with sheath of stainless steel, 3 boardtype electronic digital temperature indicators, Tubeintube heat exchanger of stainless steel : for cooling of column outlet product and for cooling of distillate, Tank of borosilicate glass, with capacity of 3 L, for collecting the column outlet product, Graduated tank of borosilicate glass, with capacity of 1 for the collection fo distillate, Piping and valves of and stainless steel, Switchboard, complying with EC conformity mark, including plant synoptic and ELCB, Emergency button Complete with: Silenced air compressor, 220240 V / 50 Hz, Air displacement: 50 L/min., Safety valve, Pressure gauge, Motor with thermal overload protection, Operating pressure: max. 10 bar controlled by a pressure switch, Noise level: 40 dB /1 m, Size of the air tank: 24 lt, Power: 0,5 HP, Refractometer Measurement range of refractive index ND 1.300 1.700, Measurement accuracy ND ± 0.0002, Mass fraction (BRIX), Temperature range: 0/70°C, Enlargement 2x

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ZM9102 Adsorption

2 adsorbers with activated carbon filling o adsorber with 8 sampling points o safety adsorber for closed water circuit o continuous process, metering pump for centralized adsorbate solution o pump for recirculating the treated water o water temperature control o digital temperature indication o flow rate adjustable, change of adsorbate concentration and contact time

Technical data

Adsorber and safety adsorber, inside diameter: each 60mm, height: each 600mm, height: each 600mm, capacity: each 1700cm3 Tanks treated water: 45L, adsorbate solution: 45L Circulation pump, max. flow rate: 180L/h, max. head: 10m Metering pump, max. flow rate: 2,1L/h, max. head: 160m Heater, max. power: 500W Measuring ranges flow rate: 0...60L/h, temperature: 0...60°C, pressure: 0...2,5bar 230V, 50Hz, 1 phase 230V, 60Hz, 1 phase 120V, 60Hz, 1 phase , UL/CSA optional

ZM9103 Batch Distillation Column

Anodized aluminum structure and panel of painted steel. Main metallic elements in stainless steel. Diagram in the front panel with similar distribution to the elements in the real unit. Sieve Plates Column with 8 plates with one temperature taking and sample, 50 mm. internal diameter and 1000 mm. length. Vacuumed, silverplated and double transparent band for vision. Column head with temperature taking and conical output for distilled product. Column head with a valve for the steam distribution. 1 Boiler (with sample outputs) with heating mantle. 2 Distillation collector of graduated glass. Refrigerator. Temperature measurement system.

7 Temperature sensors ”J” type.

Working temperature: ambient temperature up to 125°C.

Flow meter, range: 0.2 2 l./min. Manometer tubes.

Solenoid valve. Electronic console: Metallic box. o Temperature sensors connections. Digital display for temperature sensors. Selector for temperature sensors. Heating element (heating mantle) temperature control. Solenoid valve switch. Solenoid valve timer controller. (Solenoid valve reflux time control). Optional Columns (not included in the standard supply): Raschig Rings Column. 8 Plates Type Column (8 Temperature points).

10 Plates Type Column (10 Temperature points). 14 Plates Type Column (14 Temperature points).

Cables and Accessories, for normal operation.

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ZM9105 Activated Sludge Process

Activated Sludge Sewage Treatment Pilot Plant 1. General
The activated sludge pilot allows the study and the comprehension of sewage treatment by activated sludge.
This treatment is an intermediate stage between the physical treatments or gridiron, defoliation and primary sedimentation And the final sterilization and chlorination stage, in a sewage treatment, station. Its purpose is to eliminate the contaminated, Organic substances which are present in the sewage water after the above mentioned physical treatment. The organic load is measured in BOD (Biological Oxygen Demand) unit and it also causes a partial elimination of COD, (Chemical Oxygen Demand). The conditioning process takes place in a tank where the organic load is removed by microorganism (bacteria, rotifera, vorticellae, etc.) which are cultivated under aerobic conditions by blowing in air or sometimes also pure oxygen. The microorganisms utilize the contaminated substances as necessary food for their production and their preservation. The aspect for this mass of microorganisms is that, of sludge, from which we have taken the name of the Process.

After the pollutant elimination phase it is necessary to divide the clarified water from the sludge, operation which is Carried out in the settling tank (stating separator). The clarified water flows down to the receiving body, or to a sterilization, treatment, while the activated sludge is partially
recycled within the oxidation tank in order to stabilize the elimination, treatment. This pilot plant has been designed to enable the students to learn all the fluiddynamic, chemicalphysical problems arising from the realization of an activated sludge process. The unit is completely instrumented and arranged for the execution of tests that help to understand advanced problems, which come from the modern conception of activated sludge plants such as: 1 the agitation effect in the reaction tank; the energetic saving and the reliability of the sludge recirculating system by “airlift, the effect of the work oxygen concentration on the sludge elimination and sedimentation. 2. Composition, The pilot plant is composed of: 1 Basic plant (Code 944500) 6place BOD (Biological Oxygen Demand) meter (Code 994510); OPTIONAL, 1 Frigothermostat for BOD apparatus (Code 949104); OPTIONAL, Thermo reactor for COD analysis (Code 949103); OPTIONAL,

1 Electric compressor with 24 1 tank (Code 971227); OPTIONAL 1 OPTIONAL Automatic Data Acquisition System SAD/IC130D composed of: 3. Description Air line, It is composed of:

a pressure stabilizing reducer; 1 two flow rate controllers: one for the oxidation tank and the other for the sludge recirculation;, a set of service solenoid valves, 1 an air distributor/diffuser in the reactor
an “airlift” system for the sludge recirculation from the settling tank. The circuit can be supplied either by means of a compressor, or by an oxygen cylinder. Liquid line This consists of : a feed preparation tank

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with stirrer; 1 a volumetric feed pump to study dilution D (Q/V) influence; 1 a cylindrical plexiglass reactor to allow the contact among the three phases: gas/liquid/solid; 1 a plexiglass settling tank with “airlift”.

Control and regulation systems, The activated sludge pilot plant IC130D provides: 1 control of the concentration of O2 dissolved in to the oxidation tank by a sensitive element 1 measurer/indicator of O2; regulator/actuator acting on the air flow sent to the tank; control to the feed mixture temperature; 1 control of the sludge quantity in the oxidation tank by sludge recirculation driven by a timer; 1 luminous mimic panel to follow the process in real time. Measuring instruments, The pilot plant is provided with instruments to measure the quantities indicated below:I air flow rates sent to the oxidation tank and to the settling tank, sewage feed flow rate and temperature; I pH in the reaction tank; Quantity of dissolved O2. Besides, by simple operations it is possible to measure the recycled sludge quantity and the purged sludge Quantity. The following equipment is also provided with the unit: a cone to determine the percentage of sludge preset;I a set of chemical products to recreate a favourable, environment for bacterial cultures; a quantity of lyophilized bacteria; I nitrate percentage detection papers; pH detection papers, 4.Range of experiments, Determination of the purification effect according to the feed hydraulic stay time in the oxidation tank. Determination of the purification effect according to the mixing. Evaluation of the effect at different concentrations of dissolved O2. I Determination of the sludge sedimentation varying the concentration of work 02. I Influence of sludge age. Influence of pH. Efficiency of the purification according to the temperature. I Influence of the activated carbon on the purification process.

Tests using O2 instead of air. 5.Required services, Electrical supply: 220V 50/60 Hz 3 kW I Compressed air supply: 800 l/h 6 bar, I Water supply: 200 l/h 2 bar. 6.Dimensions and weights, Dimensions: with feed tank 2450 X 700 X 1700 h mm I Net weight: 270 Kg,

Pilot plant components, With reference to figure 1 the activated sludge sewage treatment plant IC130D consist of: 1.feed tank with capacity 150 l, 2.fixed speed stirrer 100 RPM, 90 W, 3.low level indicator, 4.feed cutoff valve, 5.feed discharge valve, 6.feed filter, 7.metering pump capacity 020 l/h, 8.1.5 l damper, 9.breather valve, 10.feed flow meter 60 l/h f.s., 11.fowmeter activation valve, 12.fowmeter washing valve, 13.bypass valve, 14.flowmeter washing, 15.flowmeter activation valve, 16.feed flowrate transducer (*), 17.digital totalizer (*), 18.2000 W feed heater, 19.oxidation reaction tank capacity approx 35 l, 20.200 W variable speed stirrer, 21.pH measuring device, 22.reactor discharge valve, 23.digital temperature indicatorregulator, 24.digital dissolved oxygen indicatorregulator, 25.oxygenation flow meter 500 l/h f.s. 26.oxygenation valve, 27.“airlift” valve, 28.“airlift” flow meter 500 l/h f.s. 29.“airlift” digital timer, 30.air/oxygen pressure reducer

31.deactivated sludge discharge valve, 32.digital timer for deactivated sludge discharge, 33.sludge recovery with “airlift” 34.reactor discharge, 35.settling tank, 36.deactivated sludge collection tank, 37.clarified water discharge, 38.some computerized version components, 39.console and electric panel

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ZM9108 Ion Exchange Unit

Specification

1. Softening and desalination with ion exchange, 2. cation and anion exchangers usable separately and in combination, 3. regeneration of ion exchangers, 4. tank with chambers for raw water, rinsing water, acid and caustic, 5. diaphragm pump to transport raw water, rinsing water, acid and caustic, 6. collecting tank for treated water, acid and Caustic, 7. continuous measurement of conductivity and flow rate, Technical data 2. Composition, Pump: selfpriming, diaphragm type, 1 Flowmeter range: 1080cc/min/300mL/min 1 Sump tank capacity: 30 liters, made of AISI316 stainless steel, Anion exchange resin: 1 liter, Cation exchange resin: 1 liter, Chemicals required: sodium chloride hydrochloric acid sodium hydroxide, 1 Portable conductivity meter, Portable pHmeter, 3. Required services, 1 Electrical power: 220/240V, single phase, 50 Hz

SR3004 Gas Cyclone

The unit shall perform the following experiments and investigations: Learning Objectives / Experiments, influence of solid content and volumetric air flow rate on pressure loss at the cyclone, degree of separation, separation function and separation size (with suitable analysis device), comparison of pressure loss and degree of separation with theoretically calculated values

Specification

[1] solid separation from gases with a cyclone, [2] cyclone with tangential inlet, [3] metering of feed material into the air flow with a disperser, [4] air flow generation by fan; adjustment by valve, [5] tanks for feed material and coarse material, [6] 1 filter at air inlet and 1 filter for fine material at air outlet, [7] recording of differential pressure, volumetric air flow rate and temperature

Technical Data Cyclone

height: approx. 250mm, diameter: approx. 80mm, immersion tube diameter: approx. 30mm

Fan, Volumetric flow rate: max. 600m³/h, power consumption: approx. 3600W

Tanks, feed material: 15mL,

coarse material: 700mL Measuring ranges, cyclone differential pressure: 0...100mbar, volumetric flow rate (air): 10...100m³/h, temperature: 0...60°C,

Dimensions and Weight, LxWxH: 1520x790x1800mm (trainer) Weight: approx. 160kg (trainer) LxWxH: 660x510x880mm (fan) Weight: approx. 33kg (fan)

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SR3006 Plate and Frame Filter Press

The unit shall perform the following experiments and investigations:

Learning Objectives / Experiments

learning the fundamental principle and method of operation of a plate and frame filter press, production of a suspension, removal of the filter cake, insertion of the filter cloth, fundamentals of cake filtration, Darcy's equation, variation in time of filtrate quantity and solid concentration in filtrate, mass of filter cake dependent on filtrate quantity

Specification

[1] plate and frame filter press for discontinuous cake filtration, [2] HDPE tank to produce a suspension [3] centrifugal pump to deliver the suspension to the plate and frame filter press, [4] plate and frame filter press with 10 opening separating chambers for removal of the filter cake, [5] PMMA tank with level scale for filtrate, [6] adjustment of suspension flow rate by valve, [7] thermometer and manometer in inlet, [8] portable opacimeter to measure the solid concentration in the filtrate

Technical Data

Plate and frame filter press, filter area: approx. 0,72m², working pressure: approx. 0,4...2,5bar Centrifugal pump (submersible pump), max. flow rate: 4,5m³/h, max. head: 45m Tanks, suspension tank: 200L, filtrate: 20L Measuring ranges, pressure: 0...4bar, temperature: 0...60°C

SR3007 Drum Cell Filter

The unit shall perform the following experiments and investigations:

Learning Objectives / Experiments

learning the basic principle and method of operation of a drum cell filter fundamentals of cake filtration, variation in time of filtrate quantity, filter cake mass and thickness, filter cake mass and thickness dependent on filtrate quantity, negative pressure and drum speed

Specification

[1] continuous cake filtration of suspensions with a drum cell filter [2] rotating perforated drum, partially immersed in suspension, with filter cloth, [3] vacuum inside drum to draw off filtrate and dry filter cake, [4] continuous removal of filter cake with adjustable scraper or compressed air, [5] drum speed infinitely variable, [6] plastic vacuum tank to collect filtrate, [7] suspension tank with pivoting stirrer and overflow, [8] plastic collector tank for filter cake, [9] production and transport of suspension with integrated suspension unit, [10] peristaltic pump as suspension pump

Technical Data Drum

filter area: approx. 0,1m², speed: approx. 0,1...2rpm, motor power consumption: approx. 200W Stirrer

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speed: approx. 15rpm, motor power consumption: approx. 200W Tanks, filtrate vacuum tank: approx. 30L, filter cake collector tank: approx. 8L, suspension: approx. 3L Measuring ranges, pressure: 1...0bar (vacuum tank), 0...2bar (compressed air for cake removal)

SR3023 Precipitation and Flocculation

The unit shall perform the following experiments and investigations: Learning Objectives / Experiments
familiarisation with precipitation and flocculation, effect of the pH value on precipitation, creation of a stable operating state, determination of the required metering quantities (precipitant, coagulant, flocculant), functional principle of a lamella separator

Specification

[1] precipitation and flocculation of dissolved substances (e.g. iron), [2] separate supply unit with tank and pump for raw water, [3] precipitation tank with stirring machine, [4] flocculation tank with 3 chambers and 4 stirring machines, [5] 3 metering pumps for chemicals, [6] sedimentation of the flocs in the lamella separator, [7] measurement of flow rate, temperature and pH value, [8] control of the pH value in the precipitation tank, [9] conductivity meter

Technical Data Tanks

raw water and treated water: each 300L, precipitation tank: 10L, flocculation tank: 45L, sludge tank: 15L Lamella separator, number of lamellas: 6, angle of inclination of lamellas: 60°, Raw water pump, max. flow rate: 180L/h, max. head: 10m Metering pumps, max. flow rate: each 2,1L/h, max. head: each 160m Stirring machines, max speed: each 600rpm Measuring ranges, flow rate: 15...160L/h, pH value: 0...14 temperature: 0...60°C, conductivity: 0...2000µS/cm

SR3024 Water Treatment Plant

The unit shall perform the following experiments and investigations: Learning Objectives / Experiments
familiarization with the fundamental principle of the unit operations depth filtration, and ion exchange, observation and determination of pressure losses in a sand filter, plotting of Micheau diagrams principle of backwash, identification of the different modes of cation and anion exchangers, regeneration of ion exchangers

Specification

[1] water treatment with depth filtration and ion exchange, [2] sand filter, cation and anion exchanger
[3] all processes usable separately or in combination, [4] backwash of sand filter, [5] regeneration of ion exchangers, [6] differential pressure measurement of sand filter, [7] 20 tube manometers to measure the pressures in the filter bed, [8] plotting of Micheau diagrams, [9] measurement of flow rate, temperature,

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conductivity, differential pressure and system pressure, [10] filter velocity adjustable, ComputerSystem with 21" TFTMonitor Win 10 engl.

Technical Data

Raw water pump, max. flow rate: 25m³/h,

max. head: 20m Backwash pump, max. flow rate: 3m³/h,

max. head: 37m, Tanks for raw water and treated water,

capacity: each approx. 180L

Measuring ranges, flow rate (raw water): 0...1300L/h,

flow rate (regeneration): 2...25L/h, differential pressure: 1...1bar,

system pressure: 0...4bar, tube manometers: 20x 0...1500mm, conductivity: 0...600µS/cm,

temperature: 0...100°C, filter velocity: approx. 0...70m/h, Dimensions and Weight

ZM8101 Water Treatment Trainer

Reverse osmosis means using the pressure big enough to make the solvent (in general it is water) in solution separation through reverse osmosis membrance(it is a kind of semipermeable membrane), the direction is opposite with osmosis direction. We can use reverse osmosis process which is bigger than osmosis pressure to do separation, purer or concentration the liquid. By using osmosis technology, we can efficiently remove the melting salt, colloform, bacteria, virus, Bacterial toxin and most organics etc.

1.Reverse osmosis takes physical method without phase change to desalt the brackish water under room temperature. Desalinization rate of ultrathin complex film can be up to 99.5%, and it can remove colloid, organics, germ, virus and so on at the same time.

2.It takes imported reverse osmosis film, desalinization rate is high, service life is long, operation cost is low and so on.

3.It takes fullautomatic pretreatment system which can achieve unmanned operation.

4.It takes imported Grundfos booster pump, high efficiency, low noise, stable and reliable. 5.Online water quality monitoring control, it achieves real time monitoring on water quality change, to ensure water quality safety. 6.Fullautomatic electronic control program, it can be operated with optional touch screen, easy to use. 7.Individualized design according to local water quality, meet requirement in all directions. 8.Equipment floor space is small, required space is small.

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ZM7143 Rotary Vane Vacuum Pump

vacuum generation with a rotary vane pump, vacuum generation in a steel pressure vessel, oil separator with tank on the delivery side of the rotary vane pump, manometer to display the pressure in the vessel, 1 inlet line with needle valve, 1 inlet line with needle valve and flow meter on the pressure vessel for simulation loads and leaks

2 silencers to reduce flow noise

Technical Data

Rotary vane pump, max. flow rate: 5m³/h, final vacuum: 0,02mbar, motor power output: 370W, Volume of pressure vessel: 20L, Oil separator, degree of separation: 99,98%, capacity of tank: 150mL, Measuring ranges, pressure: 1...0bar (resolution: 0,02bar), flow rate: 0,4...4Nm³/h, Dimensions and Weight, LxWxH: 1000x550x580mm, Weight: approx. 60kg

ZM7147 Training System: Flow Control

experimental unit for control engineering experiments, flow control system with variablearea flowmeter, electromagnetic proportional valve as actuator, turbine wheel flow sensor, generation of disturbance variables by altering pump speed, process schematic on front panel

Technical Data

Storage tank, capacity: approx. 3000mL, Pump, power consumption: 18W, max. flow rate: 8L/min, max. head: 6m, Rotameter: 20...250L/h

Proportional valve: Kvs: 0,7m³/h, Flow sensor: 0,5...3L/min, process schematic with controller type selection (manual, continuous controller, twoor threepoint controller, programmer) , time functions, simulation function, disturbance variable input, Dimensions and Weight, LxWxH: 600x450x600mm, Weight: approx. 21kg

ZM7148 Training System: Temperature Control

experimental unit for control engineering experiments, temperature control of a heated metal bar, heating and cooling by Peltier element, temperature sensors at 3 different points along axis of bar to establish thermal lags, process schematic on front panel

Technical Data

Heated bar: DxL: 20x200mm, aluminium, Peltier element, power consumption depending on temperature power at 300K: 38,2W, power at 50°C: 44,3W, operated by DC voltage,

Fan, power consumption: 2W

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max. flow rate: 40m³/h, Temperature sensor: 0...100°C,
Thermometer: 0...100°C, Temperature control range: 0...100°C, process schematic with controller type selection (manual, continuous controller, two or three point controller, programmer) ,
time functions, simulation function, disturbance variable input,
Dimensions and Weight, LxWxH: 600x450x260mm, Weight: approx. 16kg

ZM7150 Training System: Pressure Control

experimental unit for control engineering experiments, pressure control in a tank, speed controlled diaphragm gas pump, electronic pressure sensor, solenoid valve to generate disturbance variables process schematic on front panel

Technical Data

Diaphragm gas pump , max. flow rate: 3L/min, max. positive positive pressure: 1bar, max. negative pressure: 250mbar abs. Pressure tank, capacity: 400mL
operating pressure: 1bar, max. pressure: 10bar,
Pressure control range: 0...1bar,
Solenoid valve: Kvs: 0,11m³/h, Pressure transducer: 0...1bar,
Manometer: 0...1bar, time functions, simulation function
disturbance variable input,
Dimensions and Weight, LxWxH: 600x450x340mm, Weight: approx. 18kg

ZM7151 Training System: Level Control

experimental unit for control engineering experiments, level control process with transparent tank, speed controlled pump, level measurement by pressure sensor, disturbance variables generated by electromagnetic proportional valve in tank outlet, tank with overflow and graduated scale process schematic on front panel

Technical Data

Levelcontrolled tank, capacity: 1200mL, Storage tank, capacity: 3700mL
Pump, power consumption: 18W, max. flow rate: 8L/min, max. head: 6m
Proportional valve: Kvs: 0,7m³/h, Pressure sensor: 0...30mbar (0...300mm)
process schematic with controller type selection, (manual, continuous controller,
two or threepoint, controller, programmer) ,
time functions, simulation function, disturbance variable input

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SR1120E SEDIMENTATION STUDIES APPARATUS

DEMONSTRATION CAPABILITIES

Effect of initial concentration on sedimentation rates construction of settling rate curves from a single batch test effect of initial suspension height on, sedimentation rates effect of particle size distribution use of flocculating additives. **ORDERING SPECIFICATION:**Five graduated, 1m long x 51mm bore cylinders mounted vertically on a backboard. Cylinders are illuminated from behind and removable for cleaning. Supply includes stop clock, three 2 litre capacity plastic beakers and a specific gravity bottle. Demonstration capabilities: effect of initial concentration on sedimentation, on sedimentation rates construction of settling rate curves from a single batch test effect of initial suspension height on sedimentation rates effect of particle size distribution use of flocculating additives.

RECOMMENDED INSTRUMENTS: Triple, Beam Top Loading Balance, Capacity: 2610g, Sensitivity: 0.1g, Tare: 225g **SERVICES REQUIRED:** Electrical supply: 220240V/1ph/50Hz

ZM8110 DEEP BED FILTER COLUMN DEMONSTRATION CAPABILITIES

measuring how fast total head loss increases with filtration run , measuring pressure drop profiles through the filter bed, measuring suspension concentration profiles through the filter bed , demonstration of reversed flow fluidisation and backwashing, the column may be readily adapted for absorption and ion, Exchange studies.

TECHNICAL DETAILS

Filter column: Clear acrylic, 100mm internal, diameter x 1350mm long, Typical media depth: 700mm, Gauze mesh size: 0.35mm, Sump tanks: 2 capacity 350 litres each, Flow meter range: 0.5 5.0 litres/min, Manometers: 41 tube multibank, Pump rating: 0.37Kw

ORDERING SPECIFICATION: A clear perspex column (100mm internal diameter x 1350mm long) mounted in a floor standing framework approximately 2m high. Service system comprises of: pump, 2 sump tanks (each 350L capacity), flow controller, rotameter is supported by a corrosion resistant gauze mesh below which is packed 1kg of 10mm Ballotini. Slotted sample tubes penetrate the filtration medium at various depths. Sampling and manometer tappings are located at 20mm depth intervals staggered in position over 0.8m column height. Control valves fitted to the sampling tubes allow is okinetic sampling.

ESSENTIAL EQUIPMENT: Filter Media: Approx 10kg of a test medium is required to pack the column. Suitable alternatives include well rounded quartz grain sand BS1630 mesh (1.00.5mm), anthracite, crushed flint or aluminium oxide.

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RECOMMENDED A CCESSORIES: 40 sample collectors (test tubes or bottles), Turbidi meter or Spectrophotometer, Flexible tubing for drain connection etc. 1 metre rule, Air foot pump and pressure tubing (2.5m)

SERVICES REQUIRED: Electrical supply: 220240V/1ph/50Hz , OVERALL DIMENSIONS, Height: 2.2m, Width: 2.4m,Depth: 1.0m

ST1119 training bench of flow and level control

1 Product overview 1.1 overview: This training device includes electromagnetic valves, pumps and control object, through the relevant experiment, can be familiar with all kinds of sensor application methods and pump operating characteristics, such as to master its control principle and control mode. **1.2 Features:** (1) training adopts aluminum frame type structure, the control object and actuators integrated installation, practical circuit and device adopts security terminal adapter, each unit with flexible, easy to use, not easy to damage. (2) the experimental circuit and devices are fully configured and can be used in combination to complete the training contents of variety of subjects. (3) training platform has a good security system.

2 performance parameters: (1) input power: 230V plus or minus 10% 50Hz, (2) external dimensions: 600mm x 500mm x 1600mm (3) unit capacity: < 1KVA, (4) weight: < 60kg,

3 product composition: 3.1 control objects: Using transparent acrylic water column, the liquid level change can be observed with the liquid level sensor and flow sensor.

3.2 power supply configuration: (1) single phase three wire power supply input, through leakage circuit breaker control output, with emergency stop control button, press the emergency stop button breaker to cut off the power. (3) equipped with power indicator, European power output socket and secure type power supply terminal. (4) built in ac power, with short circuit protection. (5) builti n dc power, with short circuit protection. **3.3 supporting devices:** (1) the cylindrical transparent water tank 4 piece, (2) 1 piece transparent storage tank, (3) solenoid valve 4 piece, (4) 1 piece water pump, (5) flow sensor 1 piece, (6) liquid level sensor 4 piece, (7) water level switch 4 piece, (8) PLC module 1 piece, (9) PID controller 2 piece, (10) pipe fittings and joint sets

4. Complete training contents:

1. Liquid level control experiment, 2. Flow control experiment,
3. Liquid level and flow control experiment of open loop and closed loop,
4. Liquid level and flow cascade regulation experiment, 5. P,PI,PID control experiment,
6. Application of industrial controller,
7. The configuration control experiment of liquid level and flow, 8. Comprehensive control experiment of liquid level and flow of water tank

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