BERMAN, L. D.

USSR/Processes and Equipment for Chemical Industries - Processes and Apparatus for Chemical Technology, K-1

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 63910

Author: Berman, L. D.

Institution: None

Title: Effect of a Flow of Matter on Convective Heat Emission During Evaporation and Condensation

Original Periodical: Teploenergetika, 1956, No 2, 25-30

Abstract: Effect of mass exchange (ME) on intensity of convective heat exchange (HE) is evaluated in a conflicting manner by different authors which is due by the lack of a generally accepted procedure of determining the coefficient of heat emission α in HE processes in the presence of a transversal flow (normal to the surface of partition of the 2 phases). With certain simplifications there is provided a derivation of the dependence of α charge in the presence of ME. On calculation of α taking into account the heat transmitted solely by heat conductivity

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USSR/Processes and Equipment for Chemical Industries - Processes and Apparatus for Chemical Technology, K-1

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 63910

Abstract: (without including the heat transferred by the matter), ME increases α in the case of condensation, and decreases it in the case of evaporation, in comparison with the instance of a pure HE. The effect of ME is noticeable with considerable densities of the transversal flow of matter, and need not be taken into account in engineering computations of processes of drying, evaporation cooling, air conditioning, non-isothermic absorption, heterogeneous chemical reactions, etc.

Card 2/2

BERMAN, L.D.

AID P - 4380

Subject : USSR/Power Engineering

Card 1/1 Pub. 110 a - 6/17

Author : Berman, L. D., Dr. Tech. Sci. All-Union Heat Engineering Institute

Title : The influence of air concentration in a steam-air mixture upon evaporation rate.

Periodical : Teploenergetika, 5, 30-34, My 1956

Abstract : Theoretical and experimental data are reported showing a considerable increase in the volume-loss ratio with a decrease of the air concentrate in the steam-air mixture, and the relation between volume-loss ratio and the criterion of partial steam pressure depending upon the total pressure of the mixture. Six diagrams.

Institution : None

Submitted : No date

BERMAN, L.D.

AID P - 4957

Subject : USSR/Engineering

Card 1/1 Pub. 110-a - 6/21

Authors : Berman, L. D., Dr. Tech. Sci., and S. N. Fuks, Kand. Tech. Sci.

Title : Improving the water seal of steam condensers used with superhigh pressure turbines.

Periodical : Teploenergetika, 8, 25-31, Ag 1956

Abstract : Methods are examined for improving the joints between condenser tubes and headers. The composition of alloys used for condenser tubes is given in Table 2. 2 tables, 10 diagrams.

Institution : All-Union Heat Engineering Institute

Submitted : No date

BERMAN, L.D.

USSR / Atomic and Molecular Physics. Heat. D-4

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9039

Author : Berman, L.D.

Title : Remarks on the Article by L. Ye. Kalikhman "Turbulent Boundary Layer of Incompressible Liquid on a Porous Wall."

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 11, 2604 - 2606

Abstract : Concerns Referat Zhur - Fizika, 1956, 16515.

Card : 1/1

BERMAN, L.D.

[redacted]

Calculated back pressure for large steam turbines. Elek.sta. 27 no.8:59-60 Ag '56. (MLRA 9:10)

(Steam turbines)

BERMAN, L.D.

The treatment of experimental data on the over-all coefficients of heat and mass transfer between liquid and gas (steam) phases. L. D. Berman. *Zhur. Priklad. Khim.* 29, 138-41(1956).—The use of Kirpichev's criteria *Ki* as a short cut to the difficult exptl. detn. of the necessary coeffs. of film resistances is not justified theoretically and leads to errors. *Ki* is only another form of Nusselt's criteria, and expressing it as a function of Reynold's and Prandtl's nos. does not remove the fact that it is only an empirical relation not based on the theory of similitude. I. Bencowitz

PM

BERMAN, Lev Davidovich; KORBUSH, K.I., redaktor; LARIONOV, G.Ye., tekhnicheskiy redaktor

[Evaporative cooling of circulating water] Isparitel'noe okhlazhdenie tsirkuliatsionnoi vody. Izd. 2-oe, perer. Moskva, Gos. energ. izd-vo, 1957. 318 p. (MLRA 10:6)

(Evaporating appliances) (Cooling towers)

BERMAN, L.D., dokter tekhnicheskikh nauk; STOLYAROV, B.M., inzhener.

Experimental data on the effect of a flow of substance on the heat and mass exchange during condensation. Teploenergetika 4 no.1:49-52 Ja '57. (MIRA 10:3)

(Condensation) (Steam flow)

646

AUTHOR: Berman, L.D. Doctor of Technical Sciences (All-Union Thermo-technical Institute).

TITLE: Experimental investigations of the condensation of steam in the presence of non-condensing gases. (Eksperimental'nye issledovaniya kondensatsii para v prisustvii nekondensiruyushchikhsya gazov.)

PERIODICAL: "Teploenergetika" (Thermal Power), 1957, Vol. 4, No. 6, pp. 43 - 50 (U.S.S.R.)

ABSTRACT: This article reviews the work of a number of authors (mostly Russian) performed during the last ten years on the subject of condensation of steam in the presence of non-condensing gas. The main processes of the film-wise condensation of steam from a steam-gas mixture are governed by three coefficients: the heat transfer coefficient from the steam/gas mixture to the surface of the condensate film; the coefficient of mass transfer from the mixture to the film; and the coefficient of heat transfer from the external surface of the condensate film to the wall. The first two coefficients are governed by "external" conditions of heat and mass exchange and the third by the conditions of heat transfer within the film of condensate.

One of the heat transfer coefficients commonly used in calculations on experimental data is the "external" heat transfer coefficient which covers both convective heat exchange between the steam/gas mixture of the condensate film and the heat released during the condensation of steam. Another coefficient which is commonly used is the coefficient of heat

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transfer from the mixture to the wall. These coefficients are conventional in that they do not separate the various physical processes of heat and material transfer and therefore experimental relationships for these coefficients cannot be represented in a generalised form. Being only empirical relationships their range of application is restricted.

Because of the occurrence of steam condensation and pressure drop in the mixture, conditions in the system change appreciably as the process progresses, which affects calculations based on experimental results and the design of heat exchange equipment (2, 3).

In a previous review article Berman (1) noted the inadequacy of data on steam condensation from moving mixtures. This question was later studied in detail by Berman and Fuks at the All-Union Thermo-technical Institute. Experiments were carried out on the condensation of steam containing admixtures of air in a single horizontal tube and in an 11-row bundle of horizontal tubes. Some of the results are presented in the form of graphs in Figs. 2 and 3, which give the heat transfer coefficient as a function of the air content for a variety of experimental conditions and the relative change in the heat transfer coefficient with transverse flow of cooling medium

Experimental investigations of the condensation of steam in the presence of non-condensing gases. (Cont.)

over a single horizontal tube. It was shown that the influence of the rate of flow rises appreciably with increase in the air content of the mixture. The reasons for this are explained. An empirical formula was used to represent the results of the experiments for the range of mixture weight, speeds from 0.1 to 3 kg/m^2 sec. Some of the factors in the formula are derived from a graph, which is given. Values of the mass transfer coefficients were derived from the same experimental results and are expressed in a formula (see also (5)). This shows that velocity of flow has more influence on the coefficient of mass transfer than on the external or film heat transfer coefficients.

Rachko (7) was making similar tests at the same time, but this author arrived at a number of improbable conclusions which are both self-contradictory and in disaccordance with the results of all other investigators. Rachko's results are described and some of the reasons why he is wrong are stated. With reference to work of the Central Boiler Turbine Institute and of the All-Union Thermo-technical Institute (9), Fastovskiy and Rovinskiy (10) determined the heat transfer coefficient on a flow of steam/air mixture in a vertical pipe. The increase in this coefficient with increase in the initial velocity of the mixture, illustrated in Fig. 5 is, in this case, a result not only of the actual speed of the mixture but also of the reduction of the degree of condensation of the steam with increase in the flow to the condenser.

Kirschbaum and Wetten (11) (‥) made similar tests on the flow of a steam-air mixture in a vertical annular channel, measuring the temperatures at nine different heights and determined the mean integral temperature difference. The temperature distribution is shown in Fig. 6. Their results differ somewhat from those of Fastovskiy and Rovinskiy and a graph is given (Fig.7) of the mean heat transfer coefficient for condensation on the outside surface of a vertical tube. The main reason for the difference is that in the work of Fastovskiy and Rovinskiy the degree of condensation of steam was from 72.5 - 99.2% but was much less in Kirschbaum and Weten's experiments. Therefore, their formulae do not adequately reflect the influence of the degree of condensation and so they are not very widely applicable.

The results obtained by Mazyukevich (12) who studied the condensation of ammonia vapour in the presence of various gases, cannot be used at all because of serious procedural errors in the work. With his experimental conditions he obtained a very complex spatial field of mixture velocity, temperature and gas concentration and measured the wall temperature at only one point and the mixture temperature at only two points.

Renker (13) determined local values of heat transfer coefficient during the condensation of steam in a vertical tube using four different mixtures (steam-air, steam-hydrogen, and vapours of iso-butyl alcohol with hydrogen and oxygen). The tube was sub-divided into ten sections and the heat transfer coefficients calculated for each. Despite some simplifying assumptions made by the author his results are of definite interest and confirm the influence of the mixture speed found by Berman and moreover he observed the influence on changes in the heat transfer coefficient of the properties of the inert gas, determined in particular by the value of the diffusion coefficient. The admixture of hydrogen causes a relatively smaller drop in heat transfer with concentration than does air. Renker present his results as formulae and adduces theoretical considerations to justify the form of expression used. However, his main formula can really only be considered as empirical, its main defect consists in the inclusion of the temperature difference between the mixture and the cooling water which is influenced by the intensity of heat transfer on the water side.

Data on the condensation of steam from a stationary mixture in a vertical tube were obtained by Tolubinskiy and Yampolskiy (14) the mass transfer coefficient on condensing steam from a moving mixture on vertical tubes was determined by Vishnevskiy (15), by Geiser (16) whose work has already been reviewed (17) and by Baum and Brdlik (18).

Vishnevskiy determined the gas concentration from the total

Experimental investigations of the condensation of steam in the presence of non-condensing gases. (Cont.)

pressure of the mixture and its temperature and proposed a formula for the mass transfer coefficient.

Baum and Brdlik also investigated mass transfer on condensing steam from a steam-air mixture.

A number of investigations (20, 21, 22) have been made on the condensation of water vapour from wet air at atmospheric pressure, and some results of Kirschbaum and Lipphardt are plotted in Fig. 9 which gives the mean heat transfer coefficient on condensing water vapour from wet air inside a tube. These authors give empirical formulae and nomograms which are too complicated to be useful.

Farber investigated condensation on a vertical plane surface and obtained expressions for the "external" heat and mass transfer coefficients. One of his formulae practically coincides with a formula proposed by Mikheyev (23) for the case of pure heat transfer. This and other considerations confirm the validity of the approximate analogy between the heat and mass exchanges for the particular experimental conditions used.

Maksimovskaya (24) carried out experiments for the conditions of condensation from a high vacuum when the steam pressure and temperature are below the triple point for water and the condensing steam is converted into ice. However, objections

Experimental investigations of the condensation of steam in the presence of non-condensing gases. (Cont.)

can be raised to the conclusions drawn from his work. For instance, the thickness of ice varied over the length of the tube and with time. The experimental results are presented in the form of a mathematical expression. Maksimovskaya concludes that the heat transfer coefficient does not depend on the content of partial pressure of the components of the vapour-air mixture but is a single valued function of the total pressure. However, the main formula does not allow for transfer of heat through a layer of ice or convective heat exchange between the mixture and the ice surface, and therefore the coefficient in question is not the true heat transfer coefficient but only some empirical factor upon which strict physical relationships cannot be based. Other conclusions drawn by Maksimovskaya are criticised.

9 figures, 25 literature references (20 Russian).

AVAILABLE:

Card 7/7

BERMAN, L.D.

BUYMOVICH, D., kandidat tekhnicheskikh nauk; BERMAN, L.D., doktor tekhnicheskikh nauk.

On A.V.Lykov's book "Heat and mass exchange in the process of drying." Teploenergetika 4 no.8:91-92 Ag '57. (MLRA 10:9)

1. Institut Energetiki Akademii nauk Rumynskoy Narodnoy Respubliki. (Drying)

KUTATELADZE, Samson Semenovich; BORISHANSKIY, Veniamin Mironovich; MOCHAN, S.I., RED.: ARMAND, A.A., retsenzent; BERMAN, L.D., retsenzent; DOROSHCHUK, V.Ye., retsenzent; ~~LEL'CHUK, V.L.,~~ retsenzent; PIROGOV, M.S., retsenzent; RYVKIN, S.A., retsenzent; SOKOLOV, Ye.Ya., retsenzent; ZABRODINA, A.A., tekhn.red.; LARIONOV, G.Ye., tekhn.red.

[Handbook on heat transmission] Spravochnik po teploperedache. Leningrad, Gos. energ. izd-vo, 1958. 414 p. (MIRA 12:1)
(Heat--Transmission)

BERMAN, L.D.

96-3-23/26

card 2v5

AUTHOR: Zozulya, N.V. (Cand.Tech.Sci) &Balitskiy S.A. (Engineer)

TITLE: Session on heat exchange during change of aggregate state of matter. (Sessiya po teploobmenu pri izmenenii agregatnogo sostoyaniya veshchestva.)

PERIODICAL: Teploenergetika, 1958, No.3. pp. 91-93 (USSR)

ABSTRACT: The Commission on High Steam Conditions of the Power Institute of the Acad.Sci. of thw U.S.S.R. and the Institute of Thermal Engineering of the Acad.Sci. of the Ukrainian SSR, held a scientific and technical session in Kiev on September23-28, 1957 on questions of heat exchange during change of aggregate state of matter. The session was attended by scientific workers of academic and research institutes and colleges, and workers in design institutes and industry. Forty reports were read in the plenary and sectional sessions. The main tasks of the session were to consider the research work that had been carried out, to co-ordinate research work and to determine the most promising lines for investigation into heat exchange during change of aggregate state of matter. In his report 'Some problems of the theory of heat exchange during large volume boiling in tubes' corresponding member of the Acad.Sci. Ukrainian SSR, V.I. Tolubinskiy, critically examined the best known criterial equations for boiling liquid. Dr.Tech.Sci. S.S. Kutateladze, of the Central Boiler Turbine Institute made a report about 'Some problems of the theory of crises in the mechanism of boiling' which

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systematised the results of investigations on critical densities of heat flow during boiling in large volume tubes. Dr.Phys.Math.Sci. A.A. Gukhman of the Moscow Division of the Central Boiler Turbine Institute made a report 'On the mechanism of influence of mass-exchange on heat-exchange during boiling', which analysed the influence of the developing gas phase on heat exchange during evaporation. Dr.Tech.Sci. L.D. Berman of the All-Union Thermo-Technical Institute delivered a report on the interrelationship between thermal and mass exchange during evaporation of a liquid and condensation of the steam in the presence of permanent gases. Corresponding Member of the Acad.Sci. of the U.S.S.R., G.N. Kruzhilin, discussed Tolubinskiy's report. Dr.Tech.Sci., V.G. Fastovskiy of the All-Union Electro-Technical Institute, gave information about experimental data obtained during boiling of a number of organic liquids and mixtures of them with water. Dr.Tech.Sci., B.S. Petukhov, Moscow Power Institute, pointed out the need for profound study of the mechanism of boiling of liquids. Cand.Tech.Sci., D.A. Labuntsov, Moscow Power Institute, expressed a similar opinion. The session on heat exchange during boiling in the region of moderate thermal loading heard 7 reports. Dr.Tech.Sci., V.D. Popov, (KTIPP) made a report on 'Heat transfer during boiling of crystallising solutions', Cand.Tech.Sci., V.G. Garyazha (KTIPP) presented the results of an experimental investigation of heat

Session on heat exchange during change of aggregate state of matter. 96-3-23/26

transfer during the boiling of massecuite. Dr.Tech.Sci., I.I. Chernobyl'skiy (Institute of Thermal Engineering of the Acad.Sci. Ukrainian SSR, Engineer S.A. Balitskiy (sameInstitute) and Engineer F.P. Minchenko of the Central Boiler Turbine Institute reported the results of an experimental investigation of heat transfer during boiling of aqueous solutions of lithium bromide and chloride under vacuum. Cand.Tech.Sci. I.E. Veneraki, of the Kiev Polythechnical Institute, reported the results of investigations on heat transfer of a horizontal bundle of tubes to boiling water and sugar solution under conditions of free convection and vacuum. Cand.Tech.Sci. R.Ya. Ladiyev of the Kiev Polythechnical Institute reported on 'The use of approximate thermo-dynamic similarity to establish heat transfer relationships during boiling. Dr.Tech.Sci. I.I. Chernobyl'skiy of the Thermal Engineering Institute of the Acad.Sci. of the Ukrainian SSR and Cand.Tech.Sci. G.V. Patiani of the Power Institute of the Acad.Sci. Georgian SSR reported the results of investigations on the heat transfer co-efficient when boiling Freon 12 in large volume on horizontal tubes. Contributions to the discussion were made by Cand.Tech.Sci. V.Ya. Gol'tsov (M.I.Kh.M), V.D. Popov of KTIPP, Cand.Tech.Sci. V.M. Borishanskiy of the Central Boiler Turbine Institute, Cand.Tech.Sci. N.Yu. Tobilevich (TsINS). The session on heat

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exchange during boiling in the region of high thermal loadings heard 13 reports. Engineer V.G. Chakrygin, and Cand.Tech·Sci. V.A. Lokshin of the All-Union Thermo-Technical Institute, reported on the results of experimental investigation of the influence of non-uniformity of heat exchange round the perimeter of a horizontal steam raising tube. Cand.Tech.Sci. V.M. Borishanskiy (Central Boiler Turbine Institute) reported the results of experiments on heat transfer to boiling water at super-high and near critical pressures. Cand.Tech·Sci. E.I. Aref'eva and Cand.Tech.Sci. I.T. Alad'ev of the Power Institute of the Acad.Sci. of the U.S.S.R. reported on the influence of wetting on heat exchange during boiling. Cand.Tech·Sci. Z.L. Miropol'skiy and Cand.Tech Sci. M.E. Shitsman of the Power Institute of the Acad.Sci. of the U.S.S.R., gave the results of experiments on heat transfer and permissible specific thermal loading in the steam raising tubes of boilers. Cand.Tech·Sci. N.V. Tarasova of the All-Union Thermal Technical Institute, gave the results of investigation on critical thermal loadings and heat transfer from the walls of tubes to water, and steam-water mixture. Cand.Tech.Sci. I.T. Alad'ev, Engineer, L.D. Dodonov and V.S. Udalov of the Power Institute of the Acad.Sci. of the U.S.S.R. gave a report on 'Heat Transfer and Critical Thermal Fluxes during boiling of under heated water in Tubes'. Cand.Tech.Sci. E.K. Averin of the Power Institute of the Acad.Sci. of the U.S.S.R., reported on Heat exchange during boiling under conditions of forced circulation of water'. Engineer G.G. Treshchev of the All-Union Thermo-Technical Institute, reported on 'Experimental investigation of the mechanism of the heat exchange during surface boiling'. Dr.Tech.Sci. S.S. Kutateladze and Cand.Tech. Sci. V.N. Moskvicheva of the Central Boiler Turbine Institute, considered the relationship between the hydro-dynamics of a two-phase layer with the theory of crises in the mechanism of boiling. Cand. Tech.Sci. L.S. Sterman, Engineers V.V. Morozov and S.A. Kovalev of the Moscow Division of the Central Boiler Turbine Institute, reported on 'A study of heat exchange during boiling of liquids in tubes at various pressures up to 85 atms'. Cand.Tech.Sci. E.A. Kazakova (GIAP) reported on questions of heat exchange during the critical point under conditions of natural convection. The following took part in the discussion:- Dr.Phys.Math.Sci. A.A. Gukhman, Dr.Tech.Sci. B.S. Petukhov, Corresponding Member of the Acad.Tech.Sci. Ukrainian SSR, V.I. Tolubinskiy, Cand.Tech.Sci. A.P. Ornatskiy, Dr.Tech.Sci. V.G. Fastovskiy and Cand.Tech.Sci. M.I. Korneyev. The section on heat exchange during condensation and evaporation heard 7 reports. Dr.Tech.Sci. L.D. Berman of the All-Union Thermo-Technical Institute reported on 'Heat and Mass exchange during condensation of steam from a moving steam-air mixture on horizontal tubes'. Cand.Tech.Sci. N.V. Zozuli of the Institute of Thermal Engineering

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of the Acad.Sci. Ukrainian SSR considered the study of the process of heat exchange and the hydro-dynamics of flow of a film of condensate. Cand.Tech.Sci. O.A. Kremnev, of the Institute of Thermal Engineering of the Acad.Sci. Ukrainian SSR gave the results of an experimental investigation of heat and mass exchange in models of air, and water coolers used in deep mines. Cand.Tech.Sci. K.I. Reznikovich reported on a theoretical solution of the problem of calculating the parameters of a cooled steam gas mixture. Engineer A.L. Satanovskiy reported on 'Heat exchange during air-water evaporative cooling of equipment'. Engineer L.I. Gel'man of the Central Boiler Turbine Institute reported about investigations on heat transfer during condensation of mercury vapour on a steel wall. Dotsent V.F. Yanchenko of the Ural Polytechnical Institute, Cand.Tech.Sci. O.A. Kremnev, Dr.Tech.Sci. L.D. Berman and V.A. Smirnov of the Power Institute Acad.Sci. Ukrainian SSR contributed to the discussion. The session noted the need for further development of investigations of combined processes of heat and mass exchange; further development of study of heat exchange during change of aggregate conditions of promising new working substances; a profound study of the relationships and mechanism of the process of heat exchange and the production of data for practical calculations, and recommendations for the design of new power plant. The session directed the attention of the Acad.Sci. U.S.S.R. and Gosplan U.S.S.R. to the need for rapid study of the physical properties of new working substances. It was decided to call a session devoted to convective heat exchange in uniform media in Leningrad, in 1959.

AVAILABLE: Library of Congress.

BERMAN. L. D.

96-4-17/24

AUTHOR: Berman, L. D., Dr.Tech.Sc.

TITLE: Experimental relationships for the heat-transfer coefficient of steam-turbine condensers. (Opytnyye zavisimosti dlya koeffitsiyenta teploperedachi kondensatorov parovykh turbin)

PERIODICAL: Teploenergetika, 1958, No.4, pp.82-86 (USSR).

ABSTRACT: This is an extensive general review of European and American procedures for determining the heat-transfer coefficients of condensers. The methods quoted are critically compared with Soviet practice. Although condensers are becoming more efficient, the size of turbo-alternator sets is growing and condenser sizes are growing to match. Accurate design is, therefore, of great importance. Recent work of the Heat Exchange Institute in the U.S.A. and of Brown Boveri Co. in Switzerland is described in some detail. It is pointed out that recent changes in the Institute's graphs do not correct the fundamental errors of earlier editions. The fallacy is that the influence of each factor on which the heat-transfer coefficient depends (such as the speed of the water, its temperature and purity and so on) is considered separately, whereas in fact they are

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Experimental relationships for the heat-transfer coefficient of steam-turbine condensers.

interdependent. This criticism is confirmed by recent work of Brown Boveri and the German VDEW. Reference is then made to investigations of filmwise condensation by Escher-Wyss. Conclusions drawn by Short and Brown from their work are considered to be unjustified. In the author's opinion, foreign progress towards more accurate experimental relationships for the heat-transfer coefficients of steam-turbine condensers is only just beginning. In particular, the curves of the Heat Exchange Institute, widely used in the U.S.A. and Western Europe, are not sufficiently accurate.
There are 2 tables, 3 figures and 20 references - 5 Russian, 8 English and 7 German.

AVAILABLE: Library of Congress.

Card 2/2

BERMAN, L.D., doktor tekhn.nauk.

Assuring high water density in steam-turbine condensers for unit-plan electric power stations of superhigh steam parameters. Teploenergetika 5 no.10:90-95 O '58. (MIRA 11:10)
(Condensers (Steam))

BERMAN, L.D., doktor tekhn. nauk; ZINGER, N.M., kand. tekhn. nauk

Comparing various types of air pumps for turbine condensers [with summary in English]. Teploenergetika 5 no.11:47-55 N '58.
(MIRA 11:11)

1. Vsesoyuznyy teplotekhnicheskiy institut.
(Condensers (Steam)) (Pumping machinery)

BERMAN, L.D.

Regulation of the cooling water flow in turbine condensers and oil coolers. Energetik 6 no.10:36 O '58. (MIRA 11:10)
(Steam turbines--Cooling)

BERMAN, L. D. (VTI)

"Ensuring a High Tightness of Condenser Steam Turbines in Block-assembled Power Stations Operating with Steam of Hyper-critical Parameters."

The Commission for High-parameter Steam of the Energeticheskiy institut (Power Institute) imeni G. M. Krzhizhanovskogo AN SSSR held a conference on May 16, 1958 devoted to new types of equipment for block-assembled power stations, operating at super-critical steam parameters. This paper was read at this conference.

Izv. Akad Nauk SSSR, Otdel Tekh nauk, 1958, No. 7, p. 152

SOV/96-58-8-14/22

AUTHORS: Berman, L.D. (Doctor of Technical Science) and
Fuks, S.N. (Candidate of Technical Science)

TITLE: Mass Exchange in Condensers with Horizontal Tubes when the Steam contains Air (Massoobmen v kondensatorakh s gorizontal'nymi trubami pri soderzhanii v pare vozdukha)

PERIODICAL: Teploenergetika, 1958, Nr 8, pp 66-74 (USSR)

ABSTRACT: Values of the heat-transfer coefficient related to the mean logarithmic temperature difference of steam and water are used in calculations on steam condensers and similar equipment but are not well defined because the steam contains gas, mainly air. The influence of mass exchange on the intensity of steam condensation is very complicated and the heat-transfer coefficient depends on the design of the condenser and of the air pump or ejector. Even the best of the empirical formulae do not allow accurately for all the factors that influence the heat-transfer coefficient. Experimental data for the mean coefficient, though useful, are not always adequate, particularly when comparing different designs and equipment. It is, therefore, important to accumulate the necessary experimental data

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Mass Exchange in Condensers with Horizontal Tubes when the Steam contains Air

for the determination of local values of heat- and mass-transfer coefficient. The All-Union Thermo-Technical Institute accordingly carried out three series of tests in 1950-1952, and a fourth series in 1956-1957, on the condensation of steam in the presence of air. The tests are applicable to apparatus with horizontal tubes. Earlier work gave local values of heat-transfer coefficient from the steam side, but it was very difficult to investigate mass exchange because the parameters of the condensate film and of the steam-air mixture at the phase boundary (Fig 1) could not be measured directly. According to the kinetic theory, there should be temperature and pressure jumps at the phase boundary, but they are not revealed even at very low pressures. This can be understood on the basis of recent American work, and it is now evident that these jumps may be neglected at the pressures now under discussion. The authors have already shown that equations can be formulated for heat-transfer during the condensation of moving pure steam;

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Mass Exchange in Condensers with Horizontal Tubes when the Steam contains Air

during the tests in which the expressions were derived work was also done on a steam-air mixture. A further problem was that the experimental conditions were such that it was not possible to use the usual dimensionless relationships for the coefficient of mass-transfer based on the approximate analogy between heat- and mass-transfer. Later work, published in Teploenergetika Nr 5, 1954 and Nr 8, 1955, gave an expression for the mass-transfer coefficient during the condensation of steam from a moving steam-gas mixture. When these expressions had been derived it became possible to work out test results to obtain generalised relationships for mass-transfer coefficients. The experimental equipment for the first three series of tests used a closed steam-condensing circuit (see Fig 2a). The experimental condenser was of rectangular section with internal dimensions of 309 x 522 mm. Firstly two brass tubes were installed, a main and a control tube (Fig 3a). Then to obtain higher velocities the width of the working part of the condenser was reduced

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Mass Exchange in Condensers with Horizontal Tubes when the Steam contains Air

to 80 mm and only one tube was used (Fig 3b). Next a tube bundle in an 11-row honeycomb arrangement was fitted in the condenser (see Fig 3). In all cases the outside diameter of the tubes was 19 mm and the active length 522 mm. The fourth series of tests was run to obtain data at high air-concentrations and lower speeds; for this the equipment could be somewhat simplified (see Fig 2b). The tube bundle arrangement for this test is shown in Fig 3. The measuring techniques used in the tests are described, and the mathematical treatment applied to the results is explained. During the tests the pressure of the steam-air mixture ranged from 0.047 - 0.91 atms. The ranges of variation of the other main parameters are set out in Table 1. By way of example, Table 2 gives the results for the fourth series of experiments with the Reynolds number greater than 350. Although the data were varied over a wide range, the mass exchange data for the region of Reynolds number greater than 350 could be expressed by the single equation (8). The test results for values of Reynolds number greater than 350 are given in Figs 5 - 9.

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Mass Exchange in Condensers with Horizontal Tubes when the Steam contains Air

In Figs 5, 6 and 9 most of the experimental points lie within ± 15% of the mean line. In determining mass-transfer coefficients there are, in addition to the ordinary errors of measurement, others associated with the indirect method of determining the parameters on the phase boundary. With this in mind, the results obtained may be considered satisfactory. The curves are discussed at some length. Those for the fourth series of tests, for Reynolds numbers ranging from 40 - 350, are seen in Fig 10. The equation corresponding to the mean line is given, but it must be regarded as tentative and subject to future correction. It should be used only for a first approximation, in conjunction with equation (5). A combined graph of the results of the four series of experiments is given in Fig 11. It is concluded that the tests confirmed that the mass-transfer coefficient during condensation depends on the air content of the mixture and on another criterion as well as on the Reynolds and Prandtl numbers. With decreasing gas content, the coefficient rises rapidly and tends to infinity as the

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Mass Exchange in Condensers with Horizontal Tubes when the Steam contains air

conditions of condensation of pure steam are approached. Compared to the purely empirical formulae, the equations now given for the mass-transfer coefficient make possible more reliable determinations of the general coefficient of heat-transfer from a steam-air mixture to the tube walls under various conditions.

There are 11 figures, 2 tables, 14 literature references (11 Soviet, 2 English, 1 German)

ASSOCIATION: Vsesoyuznyy teplotekhnicheskiy institut (All-Union Thermo-Technical Institute)

1. Steam condensors--Design 2. Steam condensors--Mathematical analysis 3. Steam condensors--Heat transfer

Card 6/6

BERMAN, L. D. (Dr. Tech. Sci.)

"The Provision of High-Density Condensers for Steam Turbines in Unit-type Power Stations with Super-critical Conditions."

report presented at a Conf. on New Types of Equipment of Unit-type Power Stations employing Super-critical Steam conditions, Power Inst, Acad. Sci. USSR, Moscow, 14-16 May 1958,
(brief account of report appears in Teploenergetika, 1958, No. 9, 92-95)

All-Union Thermo-Technical Inst,

AUTHOR: Berman, L.D. SOV-91-58-10-30/35

TITLE: The Regulation of the Consumption of Cooling Water in the Condenser and Oil-Cooler of Turbines (Regulirovaniye raskhoda okhlazhdayushchey vody v kondensatore i maslookhladitele turbin)

PERIODICAL: Energetik, 1958, Nr 10, p 36 (USSR)

ABSTRACT: Two readers (Tyulyugen and Bezhigitov of the City of Inta, Komi ASSR) asked whether it is worth while regulating the consumption of the cooling water in the condenser and the oil-cooler of a turbine by means of sliding valves, and if so, whether the valves on the supply or the fault lines should be used. The author answers both questions.

1. Turbines--Operation 2. Water--Applications

Card 1/1

AUTHOR: Berman, L.D. (Dr. Tech.Sci.) SOV/96-58-10-24/25

TITLE: Ensuring water-tightness of steam-turbine condensers for unit-type power stations employing super-critical steam conditions. (Obespecheniye vysokoy vodyanoy plotnosti kondensatorov parovykh turbin dlya blochnykh elektrostantsiy na sverkhkriticheskiye parametry para)

PERIODICAL: Teploenergetika, 1958, No.10. pp. 90-95 (USSR)

ABSTRACT: This article is a shortened version of a report presented to a meeting of the High-pressure Steam Commission of the Power Institute of the AS USSR, in May, 1958. It stresses the need to prevent cooling-water leakages into condensate for direct-flow boilers. Salts may enter the feed either with the make-up water or from cooling-water leakages, and must somehow be lost at the same rate. An expression is derived for the maximum permissible leakage of cooling-water into the system under various conditions; corresponding curves are seen in Fig.1. The permissible leakages are extremely small and it is, therefore, most important to make condensers water-tight. This problem arose earlier in the USSR than abroad, because they have used direct-flow boilers longer. In recent years, a good deal of work has been done in the All-Union Thermo-Technical Institute to prevent leakage at the tube plates. Cooling-water leakages through rolled joints between condenser tubes and plates have been measured in power stations and corresponding

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Ensuring water-tightness of steam-turbine condensers for unit-type power stations employing super-critical steam conditions. SOV/96-58-10-24/25

improvements have been made in the methods of rolling the joints. However, because there are inevitably variations in the diameters of tubes and holes, individual joints never remain perfect under variable operating conditions. Matters can be improved by increasing the thickness of the tube plates. Another method that has been developed is the use of water-proof protective coatings for the joints and tube plates, as sketched in Fig.2. The properties required of such coverings are described. Tests were made in the water chamber of an industrial condenser of the type shown in Fig.3a. There were two experimental condensers, each with fourteen tubes that can operate in parallel with the main condensers. The tubes of the experimental condensers were artificially vibrated and special arrangements made to measure leakage through the joints (See Fig.4.). This equipment revealed defects in several types of protective coating. The material ultimately selected for the first long full-scale test was a zinc-bitumen coating consisting of a layer of zinc 1 - 1.5 mm thick, two layers of phenol-formaldehyde varnish V-329, and two or three layers of water-resistant bitumen mastic No. 580. The method of application of this coating is described. Other materials are being tested in collaboration with the Research Institute for Synthetic Rubber, the main object being to develop a suitable elastic coating.

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SOV/96-58-10-24/25

Ensuring water-tightness of steam-turbine condensers for unit-type power stations employing super-critical steam conditions.

A further method of tackling the leakage problem is to form a second barrier inside the main tube plate, creating a 'salty' section of the condenser from which water may be drawn. This idea is illustrated diagrammatically in Fig.5., and was first tested on a model with various kinds of artificial leakages; the test results are plotted in Fig.6. It was shown that cooling-water could get into the condensate only if the leakage rate was extraordinarily high. Various constructional problems that arise with such devices are discussed. The use of double tube-plates has been considered abroad for the same purpose; diagrams of the construction are seen in Fig.7. Condensers of this kind have also been installed in Soviet power stations. In one station, sea-water is used for cooling and the replacement of corroded tubes becomes complicated when the double tube-plate is used. It is also very difficult to detect leaks on the inner plate. Fully-welded condensers with double plates have recently been put into service. They were completely assembled at the works and tested at the power station, where a number of hitherto undetected leaks were found. The leaks on the inner tube plates could not be corrected. A brief description is given of American developments in the use of welded joints in condensers. A further problem is to prevent leakages through the condenser tubes. The first essential is to use corrosion-resistant material and to inspect the tubes carefully. A number of practical examples are quoted in which

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Ensuring water-tightness of steam-turbine condensers for unit-type power stations employing super-critical steam conditions. SOV/96-58-10-24/25

elementary requirements have been overlooked. In one case, the tubes had a natural frequency of vibration equal to the turbine speed, and this caused tube failures. The possibilities of tube resonances at different cooling-water temperatures should also be considered at the design stage. Present methods of raising the pH value, or the use of chemical de-oxygenation of feed water, call for special attention because of the possibility of corrosion of brass tubes from the steam side. An example of such failure is illustrated photographically in Fig.9. There are 9 figures and 4 Soviet references.

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SOV/96-58-11-8/21

AUTHOR: Berman, L.D., Doctor of Technical Science
Zinger, N.M., Candidate of Technical Science

TITLE: The Comparison of Various Types of Air Pump for Turbine Condensers (Sravneniye raznykh tipov vozdushnykh nasosov dlya kondensatorov turbin)

PERIODICAL: Teploenergetika 1958, Nr 11, pp 47-55 (USSR)

ABSTRACT: The relative merits of different types of air pump are first discussed in general terms. Serious objections can be raised against published technical and economic comparisons between different types of air pump and so the All-Union Thermo-Technical Institute made comparative calculations, the results of which are given below. The special features of the characteristics of different types of air pumps are first discussed and the requirements applicable to air pumps on condensers are considered. The major requirements of air pumps for condensers are that they should maintain a given pressure and should operate without overload - that is, without marked increase in suction pressure when the rate of pumping air is increased. The characteristics of

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steam jet ejectors have been investigated in some detail in previous work by the same authors. When pumping a saturated steam-water mixture at a given temperature, the characteristic of a steam-jet ejector (plotted as suction pressure against air-pumping speed) consists of two sections, a fairly flat working section from zero up to some definite rate of air flow and an overload section of steeper slope as plotted in Fig.1. The working sections of the characteristics corresponding to different mixture temperatures are practically straight parallel lines, for which a formula is given. When extracting dry air, the characteristic of a steam-jet ejector is similar to that described but the working section corresponds not to constant volume output but to a volume output that increases rapidly with the pumping speed (see Fig.1.). The water-jet ejector, unlike the steam-jet ejector, has a practically constant volume output when extracting dry air and a variable output when extracting steam/water mixture. The characteristics when extracting dry air at different temperatures of the working water are given in Fig.2. Those relating to a saturated steam/water mixture appear in Fig.3. These characteristics depend upon the design and principal dimensions of the ejector and other variables. The relationship between the operation of the ejector and that of the condenser is considerably more complicated than in the case of a steam-jet ejector, since the water-jet ejector, besides its main function, also acts as an additional condenser. The volume output of mechanical vacuum pumps, belonging to the group of volume pumps, diminishes with reduction in the suction pressure. This causes mechanical pumps having a relatively large dead space (dry-piston types and water-seal types) to be of poor characteristics, so that when they are used the steam/water mixture extracted from the condenser must first be compressed to about 0.1 atm by means of an ejector. Special designs of vacuum pumps intended for operating at pressures down to 10^{-3} mmHg have more favourable characteristics which are briefly described. Since the characteristics of water-jet ejectors are quite different from those of steam-jet ejectors and of mechanical pumps, it is not possible to compare the power consumption of different types of air pumps under identical conditions. In making the calculations it was assumed that comparable air pumps should be of equal reliability if the air pumping speed rose above the designed value. Therefore, the suction pressure for a given maximum working output should be the same for all. Under these conditions the suction pressure corresponding to the maximum-rated pumping rate is less for the water-jet ejector than for the steam-jet ejector and mechanical pump (see Fig.5.). The calculations were made with reference to a 100-MW turbine with given steam and vacuum conditions. Two methods of supplying steam-jet ejectors were considered; the power equivalent of the steam consumption was evaluated and the necessary formula is given. The characteristics and location of the water-jet ejector are indicated. The volume outputs of the mechanical air pumps were the same as for the steam-jet ejectors. The calculated values of power consumption for the different types of air pump under the various conditions considered are tabulated; data are also given about the steam consumption of steam-jet ejectors and the water consumption of water-jet ejectors. It is concluded that mechanical pumps and steam-jet ejectors have the lowest power consumption provided the number of stages is well chosen and the coolers work efficiently. Mechanical air pumps operating with ballast gas have a similar power consumption as steam-jet ejectors and have the advantage of electric drive without the need for steam supply. They pull down initial vacuum quickly. They are, however, complicated and require constant inspection. Water-jet ejectors also use electric power instead of steam and they are simpler in operation than mechanical pumps but their power consumption is greater though they do give a better vacuum due to condensation of steam in the water jet.

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The Comparison of Various Types of Air Pump for Turbine Condensers

Because of this they are as economical as other types of pumps. If water-jet ejectors are used, the output of the water purification plant is increased but this too has economic compensations. Further theoretical and experimental study of water-jet ejectors is required to improve their design and to obtain further data about their operating characteristics. There are 6 figures, 1 table and 7 literature references all of which are Soviet.

ASSOCIATION: Vsesoyuznyy teplotekhnicheskiy institut (All-Union Thermo-Technical Institute)

Card 6/6

BERMAN, L.D.

Criteria of similarity for simultaneous processes of heat and mass transfer in heteregeneous systems. Zhur. tekh. fiz. 28 no.11:2617-2629 N '58. (MIRA 12:1)
(Heat--Transmission) (Mass transfer)

BERMAN, L.D.

BERMAN, L.D., doktor tekhn.nauk; KAGAN, D.Ya., kand.tekhn.nauk.

Corrosion of brass condenser tubes under the action of ammonia. Elek.sta. 29 no.1:19-23 Ja '58. (MIRA 11:2)
(Ammonia) (Brass--Corrosion) (Condensers (Steam))

BERMAN, L.D., doktor tekhn. nauk.; PROKHOROVA, Ye.I., inzh.

Improving the salt balance of the water and vapor cycle in electric power stations. Elek. sta. 29 no.10:23-28 O '58. (MIRA 11:11)
(Feed water)

BERMAN, L.D.

PHASE I BOOK EXPLOITATION SOV/3871

Usovershenstvovaniye konstruktsiy i ekspluatatsii turbinnykh ustanovok; sbornik statey (Improvement in the Construction and Operation of Turbine Units; Collection of Articles) Moscow, Gosenergoizdat, 1959. 300 p. Errata slip inserted. 1,550 copies printed.

Eds. (Title page): Ya. M. Rubinshteyn, Professor, and A. V. Shcheglyayev, Corresponding Member, Academy of Sciences USSR; Ed. (Inside book): L. N. Sinel'nikova; Tech. Ed.: P. M. Asanov.

PURPOSE: The book is intended for engineers specializing in the design and operation of turbine equipment.

COVERAGE: This collection of 22 articles deals with aspects of turbine operations, particularly, variations in the heat performance of steam turbines and computation of optimum parameters for gas turbines. Turbine performance indices and a number of methods for more accurate determination of control parameters for specific cycles are presented. No personalities are mentioned. References follow several of the articles.

AVAILABLE: Library of Congress

AC/ps/fal

L.D

BERMAN, prof., doktor tekhn.nauk; KOSTERIN, S.I., prof., doktor tekhn. nauk, retsenzent; SHLYKOV, Yu.P., kand.tekhn.nauk, red.; UVAROVA, A.F., tekhn.red.

[Heat exchangers and condensation devices for turbine units] Teploobmennye apparaty i kondensatsionnye ustroistva turbo-ustanovok. Moskva, Gos.nauchno-tekhn.izd-vo mashinostroit. lit-ry, 1959. 427 p. (MIRA 12:10)

1. Bryanskiy institut transportnogo mashinostroyeniya (for Berman).
(Heat exchangers) (Condensers (Steam))

SOV/96-59-6-14/22

AUTHOR: Berman, L.D. (Doctor of Technical Sciences)

TITLE: Combined Pumping Sets for Extracting Air from Steam Turbines and Condensers (Kombinirovannyye nasosnyye agregaty dlya udaleniya vozdukha iz kondensatorov parovykh turbin)

PERIODICAL: Teploenergetika, 1959, Nr 6, pp 73-76 (USSR)

ABSTRACT: In large unit-type power stations with super-high steam conditions it is advisable to use electrically driven air-extraction pumps which include water-jet ejectors. Soviet and foreign experience shows that water-jet ejectors compare quite well with steam-jet ejectors. The use of mechanical vacuum pumps is more contentious and their advantages and disadvantages are discussed. It has recently been recommended in the foreign technical press to extract air from turbine condensers by means of a combination of two mechanical pumps in series. Some German pumps are described and performance formulae are given. The Leibold type B pump is described in some detail and its performance is compared with that of two types of ejector in Fig 8. It is considered that the use of the type B pumping sets would give a power economy of

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SOV/96-59-6-14/22

Combined Pumping Sets for Extracting Air from Steam Turbines and Condensers

about 20 kW as compared with steam-jet ejectors. This economy, about 0.02% in the case of a 100 MW set, is obtained at the expense of considerable complication. The continued use of steam-jet ejectors is recommended except in special circumstances. Mechanical vacuum pumps, including combined units, can sometimes be justified when it is necessary to use electrical drive, but in this case the much simpler water-jet ejector is competitive.

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There are 9 figures and 20 references, of which 8 are Soviet, 2 French, 3 English and 7 German.

SOV/96-59-7-16/26

AUTHORS: Berman, L.D., Doctor of Technical Sciences, and Fuks, S.N., Candidate of Technical Sciences

TITLE: The Design of Surface Heat-exchange Equipment for Condensing Steam from a Steam/air Mixture. (Raschet poverkhnostnykh teploobmennykh apparatov dlya kondensatsii para iz parovozdushnoy smesi)

PERIODICAL: Teploehergetika, 1959, Nr 7, pp 74-84 (USSR)

ABSTRACT: In calculating the surface of heat-exchange equipment when one of the fluids is a liquid and the other is steam with a certain quantity of inert gas, allowance must be made for several factors. They are: the composition and rate of flow of the steam/gas mixture; differences of temperature and partial pressure along the path of the moving mixtures; and also differences between local heat- and mass-transfer coefficients along the path. The whole problem is very complicated and naturally there have been many attempts to simplify the calculations. These are reviewed and it is concluded that in every case the simplification is based on an insufficiently clear understanding of the mechanism of the process. As a result, the

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The Design of Surface Heat-exchange Equipment for Condensing Steam from a Steam/air Mixture

usual simplifications may give rise to very great errors in the calculations. However, it is shown in the course of the article that if experimental relationships are used for the heat- and mass-transfer coefficients it is possible to introduce certain simplifiaations into the calculations. In particular for the case of condensing steam containing air there is practically no need to make the laborious simultaneous determination of two inter-related temperatures. The procedure described in the article is based on the use of experimental relationships: it is assumed that the conditions are such that the quantity of heat transmitted from the steam/gas mixture to the condensate film by convection and the heat evolved in cooling the condensate may both be neglected, as they are small compared with the heat of phase conversion. Changes in the total pressure of the system resulting from the resistance of the heat-exchanger tubes is also neglected. The data usually provided for the purpose of making the calculations is then listea and formula (1) is given for the specific thermal

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loading of the heating surface. The coefficient of dynamic viscosity of a saturated mixture of steam and air enters into the calculations and may be obtained from the graph in Figure 2. A knowledge is also required of the heat-transfer coefficient from the water flowing in a tube to the tube walls, and may be obtained from the nomogram in Figure 3. Equation (11) is then derived: the complex C given by equation (11a) may be obtained from the graphs in Figure 4. It should be remembered that the basic equations (2), (3) and (4) were determined experimentally for horizontal bundles of tubes of a given pitch; care must be exercised in applying them to other arrangements of tubes. Moreover, formula (10) can be applied to vertical tubes only if there is laminar flow of the condensate film. By way of illustration a numerical example is given of a specific calculation of the cooling surface required for the first-stage cooler of a steam-jet injector. The necessary numerical values are given. The cooler surface is sub-divided into six

The Design of Surface Heat-Exchange Equipment for Condensing Steam from a Steam/air Mixture

sections which may be treated separately. The sections are then considered in turn and values are derived for the specific thermal loading. The calculations are repeated for a number of tube outside-wall temperatures and the results for the first of the sections are given in Table 1. Calculations on the second and successive sections are made in just the same way; the results are given in Table 2 for two variants of cross-sectional area of the steam/air duct. In the first variant the cross-section remains constant throughout and as the steam condenses the speed of the mixture falls. In the second, the cross-section diminishes as the steam condenses, so that the speed remains constant. For the first variant, which is commonly found in practice, the necessary cooler surface is 7.89 square metres, but for the second variant it is only 5.45 square metres. The results of the calculations are used to determine the number of tubes, their arrangements and other details. When examined, the results of the calculations show that the

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experimental value of the mean heat-transfer coefficient and of the heat-transfer coefficient from the steam side, obtained from balancing tests such as are usually quoted in the literature, has little meaning. To prove the point, these coefficients are calculated for each of the six sections with both variants and the results are given in Table 3. The variations in local heat-transfer coefficients and heat-transfer coefficients from the steam side as a function of the temperature difference between the mixture and water are plotted in Figure 6 and 7 for variants 1 and 2 respectively. It is shown that for the case of condensing steam containing inert gas the usual determination of the mean temperature difference does not correspond to the realities of the process and can lead to very contradictory results. The conclusions about the general inadequacy of the usual methods of calculation are fully confirmed by test results. It is quite erroneous to attempt to 'correct' values of the heat-transfer coefficient related to the mean logarithmic temperature difference by

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The Design of Surface Heat-exchange Equipment for Condensing Steam from a Steam/air Mixture

allowing for the reduction in temperature of the steam/air mixture as it condenses. Different methods of calculating the mean surface heat-transfer coefficient from the steam side are compared in Table 4 and here again it is found that the usual coefficients are quite arbitrary. It follows that in designing heat-exchange equipment in which a gas/steam mixture is condensed use should be made of methods of the type described above, which are based on experimental relationships for local coefficients of heat- and mass-transfer. The calculations cannot yet be made for all the various conditions met in practice, for lack of experimental data. It is accordingly important to determine additional data for mixtures of various vapours and gases and for tubes of various diameters arranged in different ways.

There are 7 figures, 4 tables and 23 references, of which 11 are Soviet, 7 English, 4 German and 1 French.

ASSOCIATION: Vsesoyuznyy teplotekhnicheskiy institut (All-Union Thermo-Technical Institute)

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SOV/91-59-8-21/28

8(6)

AUTHORS: Berman, L.D., Doctor of Technical Sciences and Fuks, S.N., Candidate of Technical Sciences

TITLE: The Luminescent Method of Detecting Water Leaks in Steam Turbine Condensers

PERIODICAL: Energetik, 1959, Nr 8, pp 30-33 (USSR)

ABSTRACT: The author describes a method of detecting leaks in steam turbine condensers by filling the condenser with water in which a fluorescent material ($C_{20}H_{12}O_5$) has been dissolved. The interior of the condenser tubes is then inspected by means of a quartz lamp. This method is used since 1954 by VTI. It is based on descriptions in foreign periodicals ("Engineering", 1949 and "Power", 1950). The author describes this method in detail and gives recommendatins concerning the type of quartz lamp to be used. Mineraloscopes LYuM-1 and LYuM-2 equipped with mercury quartz lamps PRK-4 and ultraviolet light filters UFS-3 or UFS-4 may be used. The filters pass light of 320-400 millimicron wavelength. Luminescent mineraloscopes were produced by the plants "Krasnog-

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The Luminescent Method of Detecting Water Leaks in Steam Turbine Condensers

vardeyets" and "Geologorazvedka". Tables 1 and 2 contain data on mercury quartz lamps PRK-2, PRK-4, PRK-5, PRK-7 and PRK-8. The author states that this method is of great importance for high-power turbines. For example, with a 150 megawatt turbine PVK-150, a 0.001% suction will correspond to an amount of 3 liters/hour of water. For medium and high pressure turbines, the permissible suction of condenser water amounts to 0.1-0.3%, while boilers with superhigh steam parameters require 0.001-0.005%. There are 1 diagram, 1 circuit diagram, 2 tables and 4 references, 2 of which are English, 1 Soviet and 1 German.

Card 2/2

BERMAN, L.D.

Some regularities of simultaneous heat exchange and mass transfer in heterogeneous systems. Zhur.tekh.fiz. 29 no.1:94-106 Ja '59. (MIRA 12:4)

1. Vsesoyuznyy teplotekhnicheskiy institut im. F.E. Dzershinskogo, Moskva.
(Heat--Transmission) (Mass transfer)

5(4) SOV/80-32-4-17/47

AUTHOR: Berman, L.D.

TITLE: General Form of the Criterion Equations for Mass Exchange in Apparatus With Fixed Phase Interface (Obshchiy vid kriterial'nykh uravneniy dlya masso-obmena v apparatakh s fiksirovannoy poverkhnost'yu razdela faz)

PERIODICAL: Zhurnal prikladnoy khimii, 1959, Vol 32, Nr 4, pp 807-812 (USSR)

ABSTRACT: The author warns against the overestimating the role of the theory of similarity in studying the processes and equipment of chemical technology, citing Kafarov [Ref. 1] who stressed its great practical importance. Some possibilities of errors are pointed out, which arise from the wrong concept that the relationship between criteria of mass exchange for the case of a fixed phase interface

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$$Nu_D = A \cdot Re^m \cdot Pr^n_D$$

General Form of the Criterion Equations for the Mass Exchange in Apparatus With Fixed Phase Interface

is analogous to the shape of heat exchange equation. Here Nu_D is diffusion criterion of Nusselt, Re is Reynolds criterion, and Pr_D is diffusion criterion of Prandtl. Although equations of this form are applicable in many practical cases, there are some peculiarities in the processes of mass exchange, such as transverse flow of substance; molar, or so-called Stephan's flow of substance, and turbulence in the layer adjacent to the interface, which destroy the similarity between the mass exchange process and the process of pure heat exchange. In the latter case, the criterion equation will look as follows: $Nu_D = \varphi\left(Re, Pr_D, \Pi_g, \varepsilon_r, \frac{R_n}{R_r}\right)$

where $\Pi_g = \frac{\Delta p_n}{p}$; R, R_n and R_r are gas constants of the mixture, its active and inert component respectively; $\varepsilon_r = \frac{p_r}{p}$ is the volume concentration of the inert component of the mixture; Δp_n is the difference between the partial pressure of the active component of the mixture in general and that at the interface; p is summary pressure of the mixture. An analysis

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General Form of the Criterion Equations for the Mass Exchange in Apparatus With Fixed Phase Interface

of experiments performed previously by the author [Ref. 20,21] combined with the results of other experiments for the case of condensation of water steam containing air admixture on horizontal pipes leads to the following equation:

$$Nu_D = C_1 \cdot Re^{0.5} \cdot Pr_D^{0.4} \cdot \Pi_g^{-1/3} \cdot \varepsilon_r^{-0.6}$$

where $C_1 = 0.60$ for a single pipe. In conclusion the author discusses the results of some other experimenters and tries to explain them.
There are 25 references, 18 of which are Soviet, 4 English and 3 American.

SUBMITTED: December 14, 1957.

Card 3/3

AUTHOR: L. Berman, Doctor of Technical Sciences SOV/66-59-1-9/32

TITLE: On the Possibility of Cooling Water by Means of Open Air to the Dew Point Temperature (O vozmozhnosti okhlazhdeniya vody naruzhnym vozdukhom do temperatury tochki rosy)

PERIODICAL: Kholodil'naya tekhnika, 1959, 36 Nr 1, pp 40-45 (USSR)

ABSTRACT: The theoretical limit of cooling of water by means of evaporation is the temperature of the wet bulb thermometer. A number of schemes have been worked out and are mentioned in the article by which it should be made possible to cool water by means of evaporative cooling down to a temperature approaching closely the dew point. In practice, however, all such attempts have failed, inasmuch as the lowest temperature attained was only slightly below the wet bulb temperature. This small difference in temperature, however, does not warrant the investment in costly and cumbersome installations which it would require to put up.

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On the Possibility of Cooling Water by Means of Open Air to the Dew Point Temperature

There are 2 graphs, 2 block-diagrams, 2 tables, and 2 Soviet references.

ASSOCIATION: Vsesoyuznyy teplotekhnicheskiy institut imeni F. Dzerzhinskogo (All-Union Thermal Engineering Institute imeni F. Dzerzhinskiy)

Card 2/2

BERMAN, L.D., doktor tekhn.nauk, red.; SINEL'NIKOVA, L.N., red.;
BORUNOV, N.I., tekhn.red.

[Condensing and regenerative steam turbine systems] Kondensatsionnye i regenerativnye ustanovki parovykh turbin; sbornik statei. Pod red. L.D.Bermana. Moskva, Gos.energ. izd-vo, 1960. 159 p. (MIRA 13:9)

1. ORGRES, trust, Moscow.
(Steam turbines--Equipment and supplies)

SOKOLOV, Yefim Yakovlevich; ZINGER, Nikolay Mikhaylovich; BERMAN, L.D., doktor tekhn.nauk, retsenzent; KOLACH, T.A., kand.tekhn.nauk, red.; LARIONOV, G.Ye., tekhn.red.

[Jet apparatus] Struinye apparaty. Moskva, Gos.energ.izd-vo, 1960. 207 p. (MIRA 13:7)
(Jets) (Hydraulic engineering)

BERMAN, L.D., doktor tekhn.nauk

Condensation devices of large contemporary turbine units.
Energetik 8 no.4:7-11 Ap '60. (MIRA 13:8)
(Steam turbines)

BERMAN, L.D., doktor tekhn.nauk; RUBINSHTEYN, Ya.M., doktor tekhn.nauk; SHCHEGLYAYEV, A.V.

Selecting the optimum cross section dimensions of the exhaust and the number of shafts for 300 to 600 MW steam turbines. Teploenergetika 7 no.10:14-22 O '60. (MIRA 14:9)

1. Vsesoyuznyy teplotekhnicheskiy institut. 2. Cheln-korrespondent AN SSSR (for Shcheglyayev).
(Steam turbines)

BERMAN, L.D., doktor tekhn.nauk; FUKS, S.N., kand.tekhn.nauk

Hermetic sealing of steam turbine condenser pipe plates. Elek.sta. 31 no.4:32-36 Ap '60. (MIRA 13:7)
(Steam-turbines)

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BERMAN, L.D.

Calculation of heat and mass transfer processes in cross flow. Zhur. prikl. khim. 33 no.12:2789-2791 D '60. (MIRA 14:1)
(Heat--Transmission) (Mass transfer)

BERMAN, L.D., doktor tekhn.nauk; MARKIN, V.P., inzh.; PROKHOROVA, Ye.I., inzh.; IL'ICHEVA, L.A., inzh.

Use of double tube plates in steam turbine condensers. Teploenergetika 8 no.7:24-29 Jl '61. (MIRA 14:9)

1. Vsesoyuznyy teplotekhnicheskiy institut i Pridneprovskaya Gosudarstvennaya rayonnaya elektricheskaya stantsiya.
(Steam turbines) (Condensers (Steam))

BERMAN, L.D., doktor tekhn.nauk

Development of designs of steam-turbine condensers.
Teploenergetika 8 no.9:78-83 S '61. (MIRA 14:8)
(Condensers (Steam))

BERMAN, L.D., doktor tekhn.nauk; LABUTIN, A.L., kand.tekhn.nauk; FUKS, S.N., kand.tekhn.nauk; MAL'SHINA, L.P., inzh.; SHMUREY, K.S., inzh.

Rubberizing of the tube plates of a steam turbine condenser with "liquid" nairit. Elek. sta. 32 no.7:6-10 Jl '61. (MIRA 14:10)
(Steam turbines) (Neoprene)

BERMAN, L.D., doktor tekhn.nauk, prof.

Determining the mean difference of enthalpies in cooling towers and air washers with cross flow. Khol. tekh. 38 no.4:34-37 Jl-Ag '61. (MIRA 15:1)

1. Vsesoyuznyy teplotekhnicheskiy institut im. F.E.Dzerzhinskogo.
(Cooling towers) (Air conditioning)

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E025/E435

AUTHOR: Berman, L.D., Doctor of Technical Sciences

TITLE: On features of the transfer of heat and matter in moving two-component mixtures

PERIODICAL: Teploenergetika, no.1, 1962, 69-74

TEXT: A study is made of the condensation of steam from two-component steam-gas mixtures, the evaporation of liquids and the cooling of porous walls penetrated by a gas: all processes accompanied by the simultaneous transfer of heat and matter in the boundary layer of a steam-gas or gas mixture. Causes of discrepancies among proposed methods of generalizing experimental results with a view to using them to calculate flow processes of heat and mass exchange in large industrial plants are considered. A number of theories both Soviet and non-Soviet are critically examined. The author assumes a steady plane flow of a binary mixture with components satisfying the equations of state of an ideal gas, the absence of external forces and chemical reactions in the mixture, negligible thermal diffusion and constant pressure of the mixture. Diffusion along the flow is neglected and the

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densities of the components perpendicular to the flow are assumed to be variable. Relations are derived for the velocities and densities of the flow, for the diffusion of the i-th component of the mixture, the continuity equation, the equations of motion of the mixture and the balance of energy equation taking account in the latter of the variation of the enthalpy of the diffusion flows. The effect of mass transfer on friction and heat transfer which depends on the "penetrability" of the walls is studied and in the case of a semi-penetrable surface the Stefan flow is taken into account. The equations of the boundary layer are the same for completely penetrable and semi-penetrable surfaces but the boundary conditions differ. Both sets of boundary conditions are given. Attention is drawn to a number of results recently published which give systems of equations apparently differing from the author's but it is shown that the equations are in reality identical with the author's and differ only in the use of the mean-mass velocity instead of the mean molecular velocity of the mixture in calculating the velocity of the diffusion flows. This fact is demonstrated and the equations used by L.Lees.

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On features of the transfer ...

E.R.G.Eckert, V.S.Avduyevskiy and Ye.I.Obrovskova are derived. The author comments that the latter equations are better adapted for analytic solutions than his own: they contain terms showing the effects of the diffusion terms explicitly. M.I.Ismailov's results (Ref.8: The theory of boundary layer during evaporation. Izd. AN UzSSR, 1959) are criticized on the grounds that the effect of diffusion and of the Stefan flow on the equilibrium of mass, momentum and energy are not taken into account and hence the results are seriously in error. The equation to unity of Prandtl's thermal and diffusion criteria for the mixture is held to be insufficient for the existence of similarity of the fields and experiments are quoted (Ref.9: L.D.Berman, Teploenergetika, no.5, 1956; ZhTF, no.1, 1959) supporting this conclusion. The supplementary parameters required to take account of the effect of mass transfer on heat in the case of a semi-permeable surface of separation of the phases are considered and relations between them determined from experimental results for the laminar boundary layer of a binary mixture on a porous plate cooled by a stream of various gases (Ref.10: D. Gartnett, K.Geyzli. Papers at

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the Conference on Heat and Mass Transfer, Minsk). There are 3 figures and 12 references: 8 Soviet-bloc, 1 Russian translation from non-Soviet work and 3 non-Soviet-bloc. The three references to English language publications read as follows:
Ref.4: L. Lees, Jet Propulsion, no.4, 1956;
Ref.5: E.R.G.Eckert et al. Jet Propulsion, no.1, 1958;
Ref.11: A. Acrivos. A.I.Ch.E. Journ., no.3, 1960.

ASSOCIATION: Vsesoyuznyy teplotekhnicheskiy institut
(All Union Heat Engineering Institute)

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BERMAN, L.D., doktor tekhn.nauk, prof.; TUMANOV, Yu.A., inzh.

Studying the heat transmission in case of the moving steam condensation on a horisontal tube. Teploenergetika 9 no.10: 77-83 O '62. (MIRA 15:9)

1. Vsesoyuznyy teplotekhnicheskiy institut.
(Heat—Transmission)

BERMAN, L.D., doktor tekhn.nauk

Construction and characteristics of the sprinkling devices of cooling systems made from case hardened asbestos sheets. Elek. sta. 33 no.4:29-34 Ap '62. (MIRA 15:7)
(Electric power plants--Equipment and supplies)

BERMAN, L.D., doktor tekhn.nauk,prof.; TUMANOV, Yu.A., inzh.

Heat emission during filmy condensation of stationary steam in a horizontal pipe. Izv. vys. ucheb. zav.; energ. 5 no.9:86-93 S '62.

1. Vsesoyuznyy ordena Trudovogo Krasnogo Znameni teplotekhnicheskiy institut imeni F.E.Dzerzhinskogo. Predstavlena otdeleniyem turbin i teplofikatsii.

(Steampipes) (Steam) (Heat—Transmission)

BERMAN, L. D., doktor tekhn. nauk

Condensers of large steam turbines. Teploenergetika 10 no.3: 82-87 Mr '63. (MIRA 16:4)

(Steam turbines) (Condensers(Steam))

BERMAN, L.D., doktor tekhn. nauk; YEFIMOCHKIN, G.I., inzh.

Experimental study of a water-jet ejector. Teploenergetika 10 no.9:9-15 S '63. (MIRA 16:10)

1. Vsesoyuznyy teplotekhnicheskiy institut.
(Steam turbines)

BERMAN, L.D., doktor tekhn. nauk; GINZBURG, E.S., kand. tekhn. nauk; DUBNITSKAYA, L.Ye., inzh.; PROKHOROVA, Ye.I., inzh.

Operational tests of tubes from alumimum alloys in condensers and water heaters. Elek. sta. 34 no.5:28-32 My '63. (MIRA 16:7)

(Pipes, Aluminum—Corrosion)
(Condensers (Steam))

BERMAN, L.D., doktor tekhn. nauk; PROKHOROVA, Ye.I., inzh.

Leakage detection in the vacuum system of a turbine unit using a halogenleakage detector. Elek. sta. 34 no.10:34-38 O '63. (MIRA 16:12)

BERMAN, L.D., doktor tekhn. nauk; YEFIMOCHKIN, G.I., inzh.

Operation of a condensing system with a water-jet ejector.
Elek. sta. 34 no.7:28-32 Jl '63. (MIRA 16:8)

BERMAN, L.D., doktor tekhn. nauk, prof.; YEFIMOCHKIN, G.I., inzh.

Special features of the work process and operating mode of a water-jet ejector. Teploenergetika 11 no.2:31-35 F '64. (MIRA 17:4)

1. Vsesoyuznyy teplotekhnicheskiy institut.

BERMAN, L.D., doktor tekhn. nauk, prof.

Approximation method for calculating heat exchange during the condensation of steam on a cluster of horizontal tubes. Teploenergetika 11 no.3:74-78 Mr '64. (MIRA 17:6)

1. Vsesoyuznyy teplotekhnicheskiy institut.

BERMAN, L.D., doktor tekhn. nauk, prof.

Norms on the hardness of turbine condensate. Teploenergetika 11 no.4:75-77 Ap '64. (MIRA 17:6)

1. Vsesoyuznyy teplotekhnicheskiy institut.

BERMAN, L.D., doktor tekhn. nauk, prof.; TUMANOV, Yu.A., inzh.

Effect of the velocity of steam on the mechanism and intensity of heat exchange with pellicular condensation on a horizontal pipe. Energomashinostroenie 10 no.5:24-28 My '64. (MIRA 17:8)

BERMAN, L.D., doktor tekhn. nauk, prof.; YEFIMOCHKIN, G.I., inzh.

Calculational relationships for water-jet ejectors. Teploenergetika 11 no.7:44-48 Jl '64. (MIRA 17:8)

1. Vsesoyuznyy teplotekhnicheskiy institut.

BERMAN, L.D., doktor tekhn. nauk, prof.; YEFIMOCHKIN, G.I., inzh.

Methods for calculating a water jet ejector. Teploenergetika 11 no.8:
92-94 Ag '64. (MIRA 18:7)

1. Vsesoyuznyy teplotekhnicheskiy institut.

BERMAN, L.D., doktor tekhn. nauk, prof.

Design of condensing systems for large turbine units. Teploenergetika 12 no.11:34-40 N '65. (MIRA 18:10)

1. Vsesoyuznyy teplotekhnicheskiy institut.