BC

a-1

(A) Theoretical basis of calculating work of adsorbents, in particular as applied to fractionation of mixtures of gases or vapours. M. DUBININ and S. JAVORONKOV. (B) Dynamics of sorption of mixtures of vapours. M. DUBININ and M. CHMUTOVA (J. Appl. Chem. Russ., 1936, 9, 1191—1203, 1204—1212).—(A) The adsorption coeff. α of one vapour by another is shown theoretically to be given by $\alpha=(C_1'-C_1)/C_2$, where C_1' is the concn. of one vapour in the issuing air during the period preceding appearance of the second vapour, and C_1 and C_2 are the initial concns. of the vapours.

(B) The above equation is shown to hold in the case of air containing EtOH and PhMe vapours passed through active C at 20°. R. T.

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION

PROCESSES AND PROPERTIES INDEX

CA

2

Investigation of the dynamics of sorption of vapor-like mixtures. M. Dubinin and M. Khrenova. *J. Applied Chem.* (U.S.S.R.) 9, 1204-13(1936).—The dynamics of sorption of EtOH and $C_6H_5CH_3$ vapors and their mixts. by an activated carbon are given, and exptl. data are tabulated. The distribution of sorbed components along the length of the C layer was investigated. The exptl. data are in complete agreement with the theoretical scheme of sorption dynamics. Ten references.

A. A. Podgorny

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

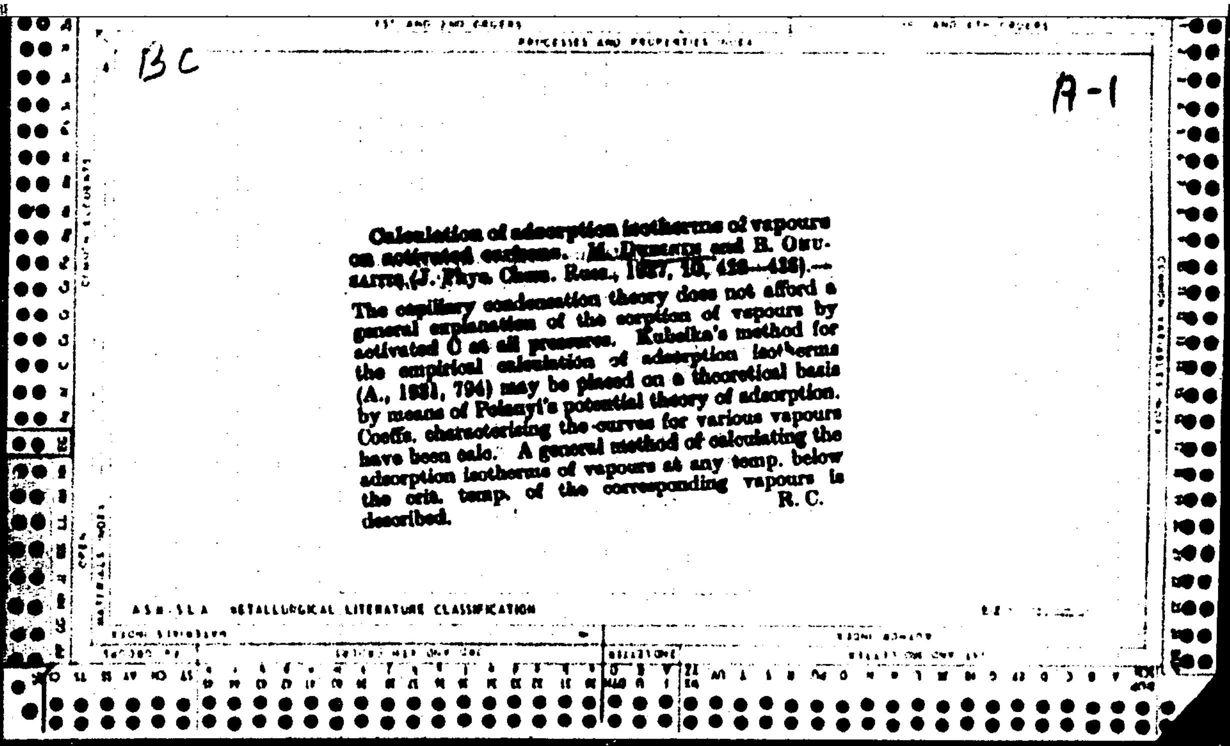
PROCESSES AND PROPERTIES INDEX

CA

18

Preparation and porosity of active charcoals. M. Dubinin and R. Zaverina. *J. Phys. Chem. (U. S. S. R.)* 9, 101-70(1937); cf. *C. A.* 31, 222. Active woodpulp charcoals were prepd. by impregnating them with $ZnCl_2$ of different concns., after varying thermal pretreatments (100-400°). Products were tested for adsorption of I, phenols and methylene blue. Activity decreases with rising temp. of pretreatment and with decrease in concn. of $ZnCl_2$. The av. pore size increases with increased concn. of $ZnCl_2$, as shown by relative sorption of homologous acids.
B. C. A.

ASB-SLA METALLURGICAL LITERATURE CLASSIFICATION



1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

BC

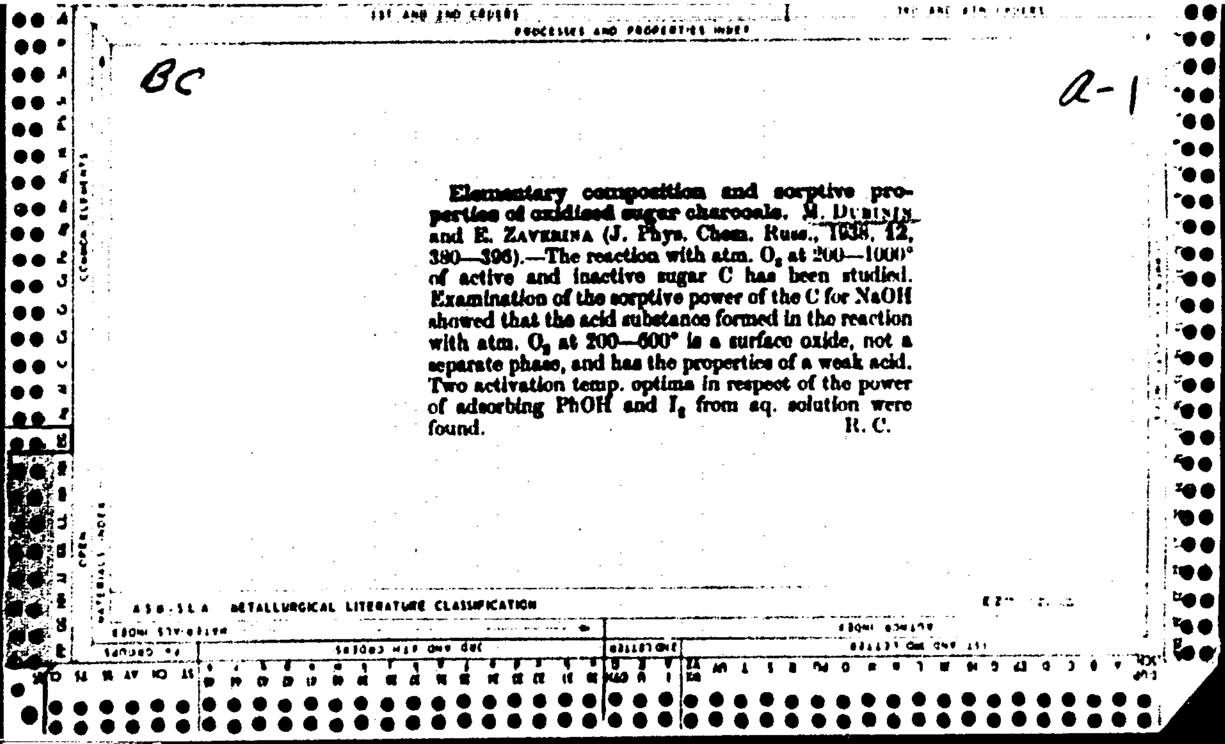
A-1

Calculation of adsorption isotherms of vapours on activated carbons. M. Dubinin and E. Ozusaitis (J. Phys. Chem. Russ., 1937, 10, 423—435).—The capillary condensation theory does not afford a general explanation of the sorption of vapours by activated C at all pressures. Kubelka's method for the empirical calculation of adsorption isotherms (A., 1931, 794) may be placed on a theoretical basis by means of Polanyi's potential theory of adsorption. Coeffs. characterising the curves for various vapours have been calc. A general method of calculating the adsorption isotherms of vapours at any temp. below the crit. temp. of the corresponding vapours is described. R. C.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

DUBININ, M. M.

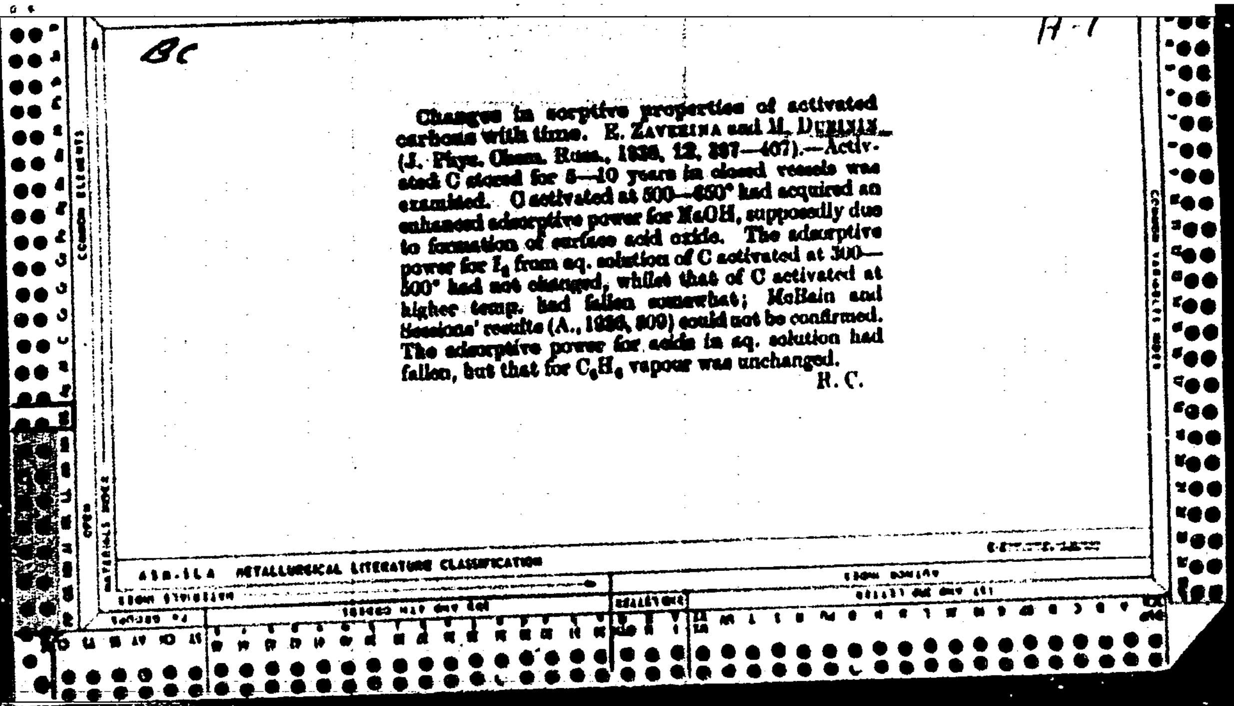
Kvoprosu o Laboratormon metode Polucheniya Chistogo Aktivnogo uglya.-Lab. Prakt., 1938, No. 6, S. 10-13, Tabl.



BC

A-1

Elementary composition and sorptive properties of oxidised sugar charcoals. M. Dubinin and E. Zaverina (J. Phys. Chem. Russ., 1938, 12, 380—396).—The reaction with atm. O_2 at 200—1000° of active and inactive sugar C has been studied. Examination of the sorptive power of the C for NaOH showed that the acid substance formed in the reaction with atm. O_2 at 200—600° is a surface oxide, not a separate phase, and has the properties of a weak acid. Two activation temp. optima in respect of the power of adsorbing PhOH and I_2 from aq. solution were found. R. C.



8c

A-1

Changes in sorptive properties of activated carbons with time. E. Zaverina and M. Dubinin. (J. Phys. Chem. Russ., 1938, 12, 397—407).—Activated C stored for 5—10 years in closed vessels was examined. C activated at 500—650° had acquired an enhanced adsorptive power for NaOH, supposedly due to formation of surface acid oxide. The adsorptive power for I_2 from aq. solution of C activated at 300—500° had not changed, whilst that of C activated at higher temp. had fallen somewhat; McBain and Sessions' results (A., 1936, 809) could not be confirmed. The adsorptive power for acids in aq. solution had fallen, but that for C_6H_6 vapour was unchanged.

R. C.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

Ca

2

Effect of surface oxides on the sorptive properties of active charcoal with respect to substances in the vapor state. E. D. Zaverina and M. Dubinin. *J. Phys. Chem.* (U. S. S. R.) 13, 151-62(1939).—From exptl. data on the adsorption of vapor-phase benzene, pentane, heptane and MeOH and aq. HCl, NaOH, H_2SO_4, formic, acetic, propionic and valeric acids, phenol, methylene blue and Congo red on fine sugar charcoals variously activated in CO_2, air or in vacuum at 350 to 1000° for 1-110 hrs., it is found that the addnl. oxidative activation produces considerable changes in porosity, so that theoretical conclusions based upon direct comparison of the isotherms before and after activation are not permissible. The adsorption potentials of the vapor-phase nonpolar substances calcd. from the adsorption isotherms are independent of the nature of the surface oxides on the charcoal; for polar vapors, the potentials are greater for more polar acidic surfaces.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

BUBININ, M. M.

K Voprosu o soprotivlenii toku vozdukha sloyev zernenykh materialov.-Zh. Prikl. Khim., 1941, T. 14, V. 7-8, S. 906-1913.

DUBININ, M. M.

Ocherednyye Zadachi Rekuperatsii Letuchikh Rastvoriteley-Khim. Prom., 1946, № 1-2, S. 20-24. (Sovmestno S. H. S. Puzhay I. B. A.

to the production of [illegible] O. M. Roslapeff

I.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

DUBININ, M.M.

7

Adsorption of vapors on active charcoals in relation to the properties of the adsorbate. M. M. Dubinin and D. P. Timofeev. *Compt. rend. acad. sci. U.R.S.S.* 54, 701-4 (1946)(in English).—The characteristic curves for different vapors are all described by the equation $E = \beta f(w)$, where E = adsorption potential, β = coeff. of affinity, and w = vol. of adsorbed vapor in the liquid state. When β is known and the adsorption isotherm of some vapor is given, the adsorption isotherm of another vapor can be computed for a given temp. β can be detd. from a knowledge of polarizabilities, van der Waals' attraction consts., or diamagnetic susceptibilities. These data are available for only a limited no. of vapors and lead to approx. values. A new method of calcg. β is suggested and tested. The polarizability of mols. varies directly (at least approx.) as the molar vol. (V) of the adsorbate in the liquid state. Therefore $\beta = V_i/V_1$. Exptl. values of β were detd. by using the sorption wt. method of Dubinin and Zaverina (*C.A.* 31, 222⁴) and compared with values calcd. by each of the methods indicated. The suggested method involves only readily available data and seems to give closer exptl. agreement than any of the other methods. The vapors used were: C_6H_6, C_6H_{12}, C_7H_{16}, C_8H_{18}, toluene, MeCl, CH_2Cl_2, $CHCl_3$, CCl_4, EtCl, MeOH, EtOH, HCOOH, AcOH, Et_2O, Me_2CO, CS_2, CCl_3NO_2, NH_3. Paul B. Clark

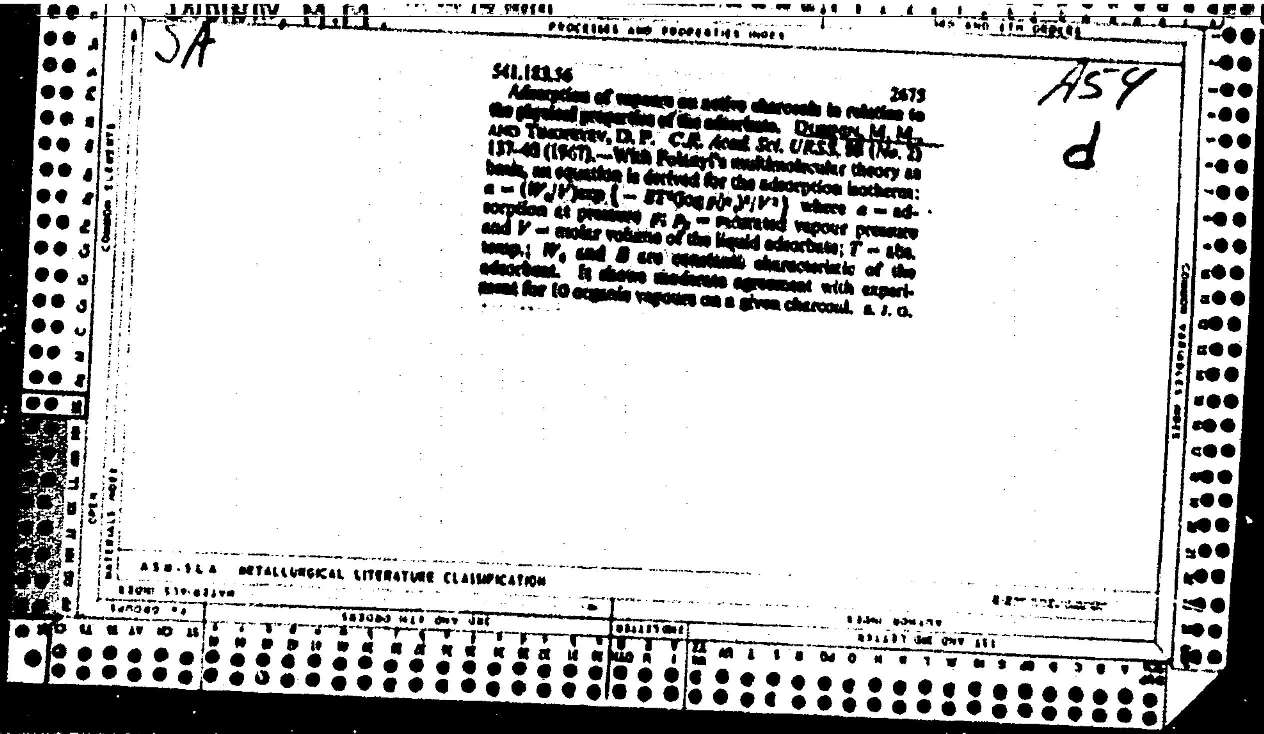
AS 1946-

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

in Russian

Adsorption of 14 vapors by two types of active C, (I) from hazel-nut shells, ash 0.36%, and (II) from anthracite + wood tar, ash 1.16%, was detd. at 20° from 0.0001 mm. Hg to satn. The app. used contained 4 quartz spiral balances and allowed simultaneous measurement of 4 isotherms. The vol. of vapor brought in contact with charcoal was varied by a special instrument. At the equil. pressure of 10 mm. Hg the amt. adsorbed increased for carbon II in the order $CH_3Br < C_2H_5Cl <$ pentane < heptane < hexane < cyclohexane < toluene < $CCl_4 < CHCl_3 < C_6H_6 < CH_3OH <$ AcOH $< HCO_2H < H_2O$, if it was expressed in mols. and AcOH and HCO_2H were assumed to be assocd. The order for C I differed but little but it was much altered when the adsorbed amts. were compared at 0.1 mm. Hg. There it was $CH_3Br < CH_3OH < C_2H_5Cl <$ pentane < $CHCl_3 < HCO_2H <$ cyclohexane < hexane < $CCl_4 < C_6H_6 <$ heptane < toluene < AcOH. This proves that comparison of amts. adsorbed at a definite pressure cannot be used for finding the relation between adsorbability and other properties of a vapor. Earlier attempts to establish such relation are discussed. 20 references.

AIB-SLA METALLURGICAL LITERATURE CLASSIFICATION



5A

AS4

d

PROCESSES AND PROPERTIES INDEX

541.183.56

2673

Adsorption of vapours on active charcoals in relation to the physical properties of the adsorbate. Dubinin, M. M., and Timofeyev, D. P. *C.R. Acad. Sci. URSS,* 55 (No. 2) 137-40 (1967).—With Polanyi's multimolecular theory as basis, an equation is derived for the adsorption isotherm: $a = (W_0/V)\exp(-BT^2(\log p/p_s)^2/V^2)$ where a = adsorption at pressure p; p_s = saturated vapour pressure and V = molar volume of the liquid adsorbate; T = abs. temp.; W_0 and B are constants characteristic of the adsorbent. It shows moderate agreement with experiment for 10 organic vapours on a given charcoal. A. J. G.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

S/Chemistry - Adsorption Feb 1947
Chemistry - Charcoal, Activated

he Characteristic Curve Equation for Active Char-
als," M. M. Dubinin, Mem, Acad Sci USSR; L. V.
dushkevich, Lab Sorption Processes, Inst Phys Chem,
ad Sci USSR, 3 pp

R Acad Sci" Vol LV, No 4, pp 327-29.

lation of adsorption potential to distance from
rface of adsorbent can be deduced analytically in
ple cases, and cannot be used for industrial ad-
rbents which are porous bodies of complex struc-
re. Polanyi's theory suggests use of characteris-
s curve of adsorbent. Authors attempt to describe
se curves by a well-founded equation, in case of
ous bodies, especially active charcoals. Sub-
ted, 9 Dec 1946.

53T22

USSR/Physics Jun 1947
Adsorption
Charcoal - Activation

"Adsorption of Water Vapors and the Structure of Activated Charcoal," M. M. Dubinin, Academician; Ye. D. Zaverina, Chem Warfare Acad, Inst Phys Chem, 4 pp

"Dok Akad Nauk SSSR, Nova Ser" Vol LVI, No 7

Discusses experimental data, illustrated with graph, and explains them by shift of adsorption branches into field of higher relative pressures, with progressive activation of charcoal and reverse effect in formation of acid surface oxides.

[redacted] 60T96

2

Adsorbability and physicochemical properties of vapors. II. Rules from the viewpoint of the potential theory of adsorption. M. M. Dubinin and D. P. Timofeev. *J. Phys. Chem.* (U.S.S.R.) 22, 133-43(1948)(in Russian); cf. *C.A.* 42, 3480d and preceding abstr.—If p is the relative pressure of a vapor, a its adsorbed amt. (in mol.) at p, and v the mol. vol. of the liquid adsorbate, then $RT \ln p = \beta f(av)$, the function f being characteristic for the adsorbent and independent of temp. and the nature of the vapor, and β being a factor characteristic of the vapor. The expts. of the preceding paper show that if β of C_6H_6 is set equal to 1, the β of MeOH, MeBr, HCO_2H, EtCl, C_2H_6, $CHCl_3$, butane, AcOH, cyclohexane, CCl_4, pentane, toluene, hexane, and heptane is 0.40, 0.57, 0.61, 0.76, 0.78, 0.88, 0.90, 0.97, 1.04, 1.06, 1.12, 1.28, 1.28, and 1.59, resp.; its values are almost identical for the two carbons used. These relative values of β are similar to the relative values of intermol. forces calcd. according to various models; however, an equally good agreement is obtained between the β values and the ratios of the mol. vols. and of the nos. of the external electrons (e.g. MeOH has 14 and C_6H_6 30 external electrons giving a ratio of 0.47). Since β is proportional to v, the general expression for adsorption isotherms is $a = (1/v)\,\phi\,(RT/v)\ln p$, ϕ being the function characteristic for the adsorbent. If it is assumed that the probability of a pore having a definite adsorption potential is given by the normal distribution, the function ϕ can be calcd., and the equation results $a = (w/v)\ \text{exp.}\ [-BT^2(\log p)^2/v^2]$, w and B being consts. of a given adsorbent; w is the vol. adsorbed at $p = 1$. Often the first approximation is sufficient, that $\ln a = (w/v) - (bT \log p/v^2)$, b and w being const. The adsorbability depends on more than one property of the vapor and also on the adsorbent. J. J. Bikerman

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

DUBININ, M. M.

USSR/Chemistry - Adsorption, of Vapors May 1948
Chemistry - Adsorption, by Active Carbon

"Problem of the Calculation of Vapor Adsorption Isotherms of Active Carbons," Academician M. M. Dubinin, D. P. Timofeyev, 3¼ pp

"Dok Ak Nauk SSSR" Vol LX, No 5, pp 821-4.

Presents method that is independent of temperature characteristic curves for various vapors and also independent of affinity characteristic curves of individual vapors during constant adsorption. Submitted 15 Mar 1948.

[redacted] 68T15

DUBININ, M. M. PA 8/49T7

USSR/Chemistry - Carbon, Active Jul 48
Chemistry - Sorption, Of Water Vapor

"Study of the Sorption of Water Vapors in Active Carbon," Acad M. M. Dubinin, Ye. D. Zaverina, 3½ pp

"Dok Ak Nauk SSSR" Vol LXI, No 1, pp 79-82.

Report of experiments. Ash-free carbon activated by sorption of various amounts of benzene or dibutylphthalate. Sorption and desorption isotherms of water vapor were then measured. Tabulates, plots, and discusses results. Submitted 5 May 1948.

8/49T7

DUBININ, M.M., akademik; TIMOFEYEV, D.P.

Computation of adsorption isotherms of vaporlike substances on activated charcoal. Dokl. AN SSSR 60 no.5:821-824 My '48.
(Adsorption) (MIRA 10:8)

DUBININ, M. M., Acad

PA 35/49T6

USSR/Chemistry - Carbon, Active, Structure Aug 48
Chemistry - Carbon, Active, Absorption by

"The Structure and Sorption Properties of Active Carbon From Phenyl-Aldehyde Tars," Acad M. M. Dubinin, Ye. D. Zaverina, 4 pp

"Dok Ak Nauk SSSR" Vol LXI, No 6, pp 1053-6

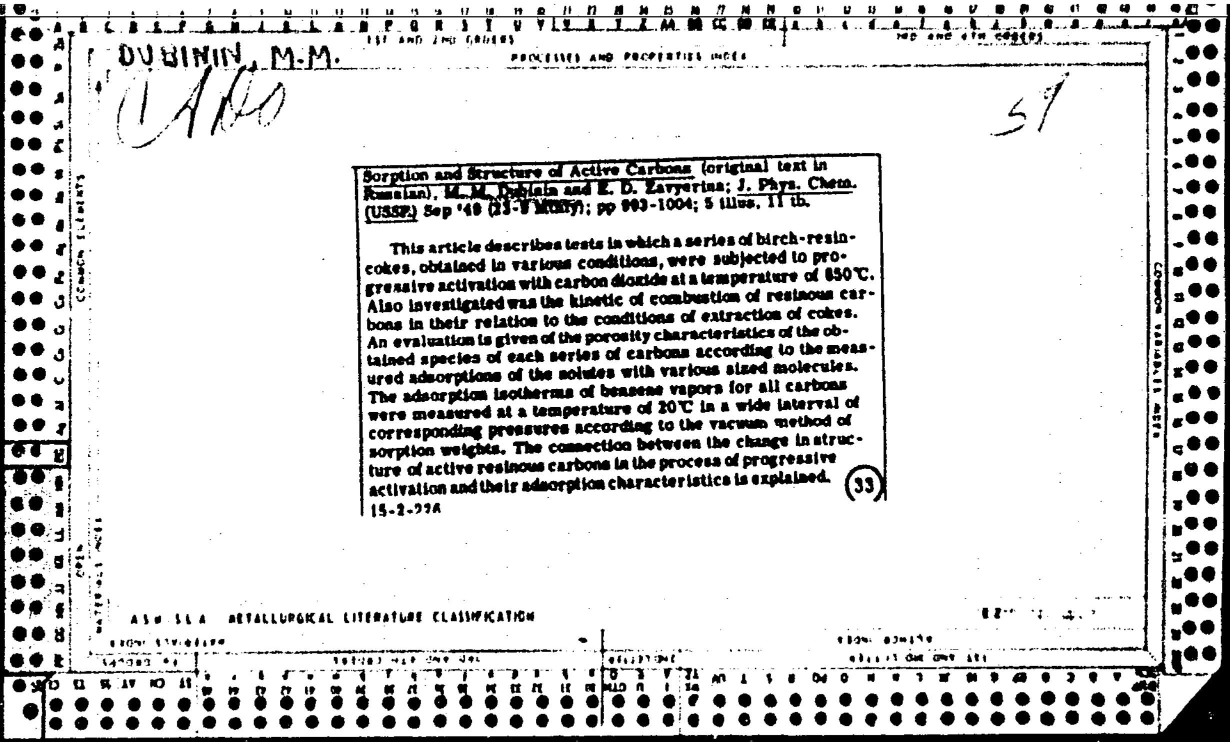
Three sets of active carbons, prepared by treating with carbon dioxide carbon prepared from bakelite at 850 - 1,000°, were tested for adsorption of substances of varying molecular sizes from aqueous solutions, such as methylene blue and Congo red. Results were compared with those for adsorption of benzene vapors at 20°. For maximum adsorption,

[redacted] 35/49T6

USSR/Chemistry - Carbon, Active, Structure (Contd) Aug 48

activation at 850° is recommended, which produces especially fine micropores. Submitted 23 Jun 48.

[redacted] 35/49T6



DUBININ, M.M.

1 APO

57

Sorption and Structure of Active Carbons (original text in Russian), M. M. Dubinin and E. D. Zavyerina; J. Phys. Chem. (USSR) Sep '49 (23-9 [illegible]); pp 993-1004; 5 illus, 11 tb.

This article describes tests in which a series of birch-resin-cokes, obtained in various conditions, were subjected to progressive activation with carbon dioxide at a temperature of 850°C. Also investigated was the kinetic of combustion of resinous carbons in their relation to the conditions of extraction of cokes. An evaluation is given of the porosity characteristics of the obtained species of each series of carbons according to the measured adsorptions of the solutes with various sized molecules. The adsorption isotherms of benzene vapors for all carbons were measured at a temperature of 20°C in a wide interval of corresponding pressures according to the vacuum method of sorption weights. The connection between the change in structure of active resinous carbons in the process of progressive activation and their adsorption characteristics is explained. (33)

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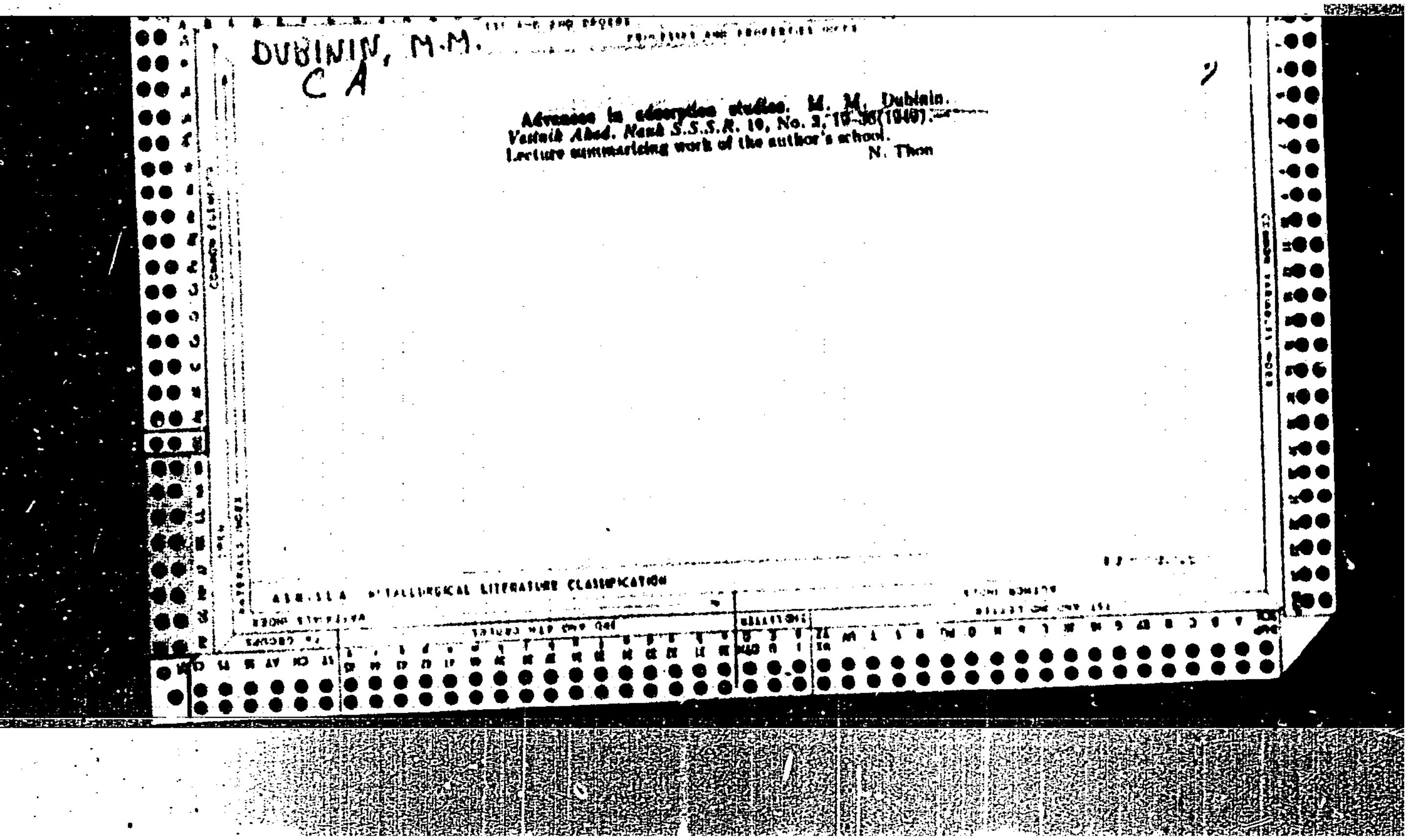


DUBININ, M.M.
CA

2

Advances in adsorption studies. M. M. Dubinin. *Vestnik Akad. Nauk S.S.S.R.* 19, No. 3, 19-30(1949). Lecture summarizing work of the author's school.
N. Thon

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

USSR/Chemistry - Carbon
Chemistry - Absorption

Jan 49

"Sorption and Structure of Active Carbons: III. Change in the type of Porosity in Carbons and Sorption of Water Vapor," M. M. Dubinin, Ye. D. Zaverina, 14 pp

"Zhur Fiz Khim" Vol XXIII, No 1, pp 57-70.

Studies curves of isotherms of sorption and desorption of water vapors on carbon obtained from sugar, which contain various quantities of adsorbed benzene vapors. Revealed that blocking with benzene of most active parts of carbon

48/49T14

USSR/Chemistry - Carbon (Contd)

Jan 49

surface leads to displacement of sorption isotherms into field of high relative pressures, similar to that observed during progressive carbon activation. These results correspond to hypothesis on nature of water vapor sorption. Gives seven graphs and ten tables of experimental results. Submitted 19 May 48.

48/49T14

PA 48/49T14

DUBININ, M. M.

USSR/Chemistry - Adsorption Apr 49
Chemistry - Carbon

"Sorption and the Structure of Active Carbons: IV, Structure and Sorption Properties of Active Carbon Obtained From Phenol-Aldehyde Resins," M. M. Dubinin, Ye. D. Zaverina, Dept of Chem Sci, Acad Sci USSR, Moscow, 14½ pp

"Zhur Fiz Khim" Vol XXIII, No 4, pp 469-83.

Studied progressive activation of coke from phenol-formaldehyde resins by CO_2 at 750-1000° C. Evaluated character of porosity of the carbon obtained by measurement of the adsorption of

[redacted] 57/49T10

USSR/Chemistry - Adsorption (Contd) Apr 49

dissolved materials with molecules of various sizes. Submitted 4 Jul 48.

~~FDD~~ 57/49T10

DUBININ, M. M.

DUBLININ, M. M.

"Sorption and Structure of Activated Carbon. V. Activated Carbon from Resinous Charcoal," Zhur. fiz. khim., 23, No.9, 1949

CA

2

Sorption and structure of active carbons. VI. The structure types of active carbons. M. M. Dubinin, K. D. Zaverina, and D. P. Timofeeva. *Zhur. Fiz. Khim.* 23, 1129-40(1949); cf. *C.A.* 44, 800i.--Exptl. data of the previous papers show that there are 3 main types of adsorption carbons: (1) carbons having very small pores, such as carbons in which the wt. loss is less than 50%; their adsorption isotherm is log a = $C - D$ (log p_s/p)^2; a is the amt. adsorbed, p_s the satn. vapor pressure, p vapor pressure, C and D are const., and D is proportional to (temp.)^2; (2) carbons having no small pores, such as carbons obtained after a wt. loss of more than 75% or nonporous carbons; their isotherm is log a = $M - N$ log (p_s/p), i.e. the Freundlich isotherm; N is proportional to temp.; (3) intermediate type; its isotherm is the sum of the 2 preceding isotherms. J. J. Bikerman

USSR/Chemistry - Carbon, Active
Chemistry - Absorption

③

"Structural Types of Active Carbons," Acad M. M. Dubinin, Ye. D. Zaverina, 4 pp

"Dok Ak Nauk SSSR" Vol LXV, No 3, pp 295-8 1949

Considers adsorption potential as a function of carbon structure. Classifies structural types of active carbons by characteristic curves. Establishes two limiting structural types of active carbons. First type corresponds to carbons moderately activated to charring not exceeding 50%, and second to

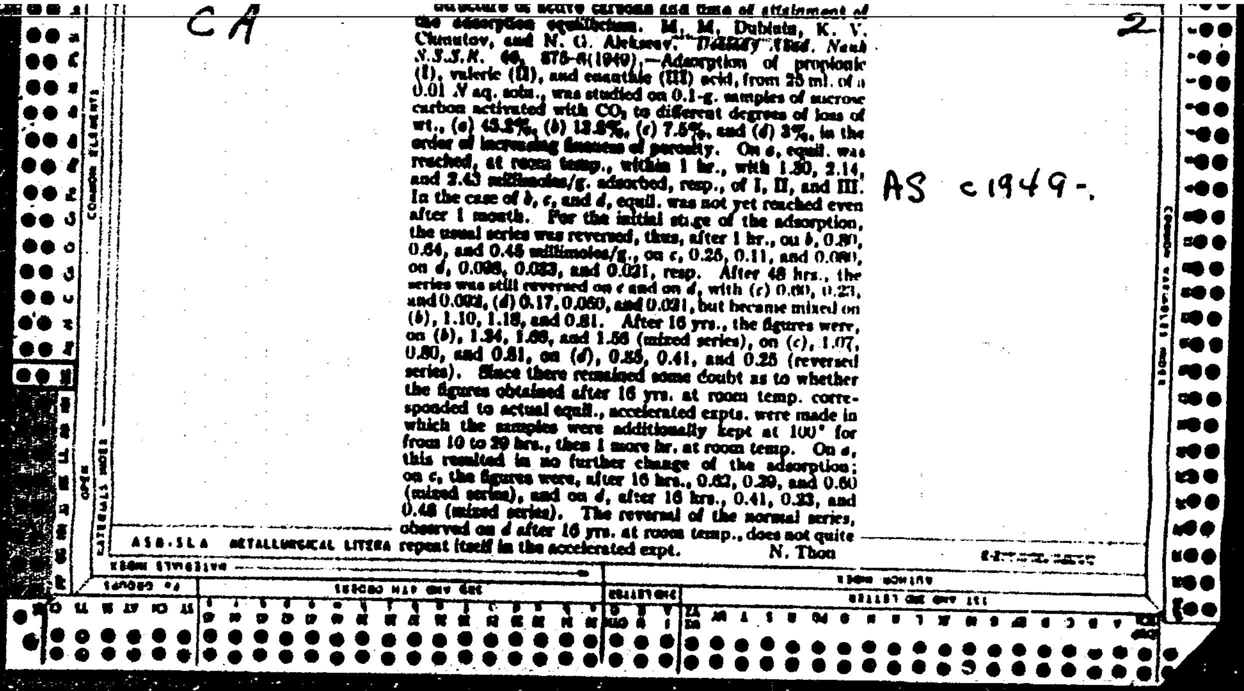
[illegible]

39/49T9

USSR/Chemistry (Contd) Mar 49

carbons fully activated to charring not exceeding 75%. Submitted 25 Jan 49.

39/49T9



CA

2

structure of active carbons and time of attainment of the adsorption equilibrium. M. M. Dubinin, K. V. Chmutov, and N. G. Alekseev. *Doklady Akad. Nauk S.S.S.R.* 66, 875-8(1949).—Adsorption of propionic (I), valeric (II), and enanthic (III) acid, from 25 ml. of a 0.01 *N* aq. soln., was studied on 0.1-g. samples of sucrose carbon activated with CO_2 to different degrees of loss of wt., (*a*) 45.2%, (*b*) 12.8%, (*c*) 7.5%, and (*d*) 3%, in the order of increasing fineness of porosity. On *a*, equil. was reached, at room temp., within 1 hr., with 1.30, 2.14, and 2.43 millimoles/g. adsorbed, resp., of I, II, and III. In the case of *b*, *c*, and *d*, equil. was not yet reached even after 1 month. For the initial stage of the adsorption, the usual series was reversed, thus, after 1 hr., on *b*, 0.80, 0.64, and 0.45 millimoles/g., on *c*, 0.26, 0.11, and 0.080, on *d*, 0.096, 0.033, and 0.021, resp. After 48 hrs., the series was still reversed on *c* and on *d*, with (*c*) 0.60, 0.23, and 0.092, (*d*) 0.17, 0.060, and 0.021, but became mixed on (*b*), 1.10, 1.18, and 0.81. After 16 yrs., the figures were, on (*b*), 1.34, 1.66, and 1.56 (mixed series), on (*c*), 1.07, 0.80, and 0.81, on (*d*), 0.55, 0.41, and 0.25 (reversed series). Since there remained some doubt as to whether the figures obtained after 16 yrs. at room temp. corresponded to actual equil., accelerated expts. were made in which the samples were additionally kept at 100° for from 10 to 20 hrs., then 1 more hr. at room temp. On *a*, this resulted in no further change of the adsorption; on *c*, the figures were, after 16 hrs., 0.62, 0.29, and 0.60 (mixed series), and on *d*, after 16 hrs., 0.41, 0.33, and 0.46 (mixed series). The reversal of the normal series, observed on *d* after 16 yrs. at room temp., does not quite repeat itself in the accelerated expt. N. Thon

AS c1949-.

ASB-SLA METALLURGICAL LITERA

USSR/Chemistry - Carbon, Active Adsorption — Sep 49

"The Structure and Adsorption Properties of Zinc-Chloride Activated Carbons," Acad M. M. Dubinin, Ye. D. Zaverina, 4 pp

"Dok Ak Nauk SSSR" Vol LXVIII, No 1, 91-4.

Along with method of activation by gaseous substances, method of obtaining active carbons by thermal decomposition of organic materials in presence of inorganic activating substances has obtained wide usage. Using zinc chloride as inorganic activating substance, studied adsorption properties and structure of activated carbons of progressing activation, character

[redacted] 2/50T36

USSR/Chemistry - Carbon, Active Adsorption (Contd) — Sep 49

of porosity of which varied within wide limits. Submitted 2 Jul 49.

[redacted] 2/50T36

DUBININ

Adsorptive Properties and Structures of Silica Gels and "Aluminogels." (In Russian.) M. M. Dubinin and A. G. Zuev. *Doklady Akademii Nauk SSSR* (Reports of the Academy of Sciences of the USSR), new ser., v. 69, Nov. 11, 1949, p. 209-212.

Attempts to apply the equations of the adsorption isotherm, developed for two types of activated carbon, to the above. Tabulated and charted data indicate that the above adsorbents are similar to the carbon with large micropores.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

DUBININ, M. M. and Zaverin, Ye. D.

"Adsorption and Structure of Adsorbents," a paper presented at a meeting of the Department of Chemical Sciences, Vestnik Acad. Sci., 3/50

This was of particular interest to scientists at the Chem. Inst., Georgian Acad. Sci who at the present time are studying local natural adsorbents (bentonite clays).

DUBININ, M.M.

"Soviet Chemistry in the Stalin Epoch (In Honor of I. V. Stalin's 70th Birthday)," Uspekhi Khim., 19, No. 1, 1950. Moscow, -c1950-.

CA DUBININ, M.M.

In memory of I. I. Zhukov. S. I. Vol'fkovich, M. M. Dubinin, and P. A. Rebinder. *Uspekhi Khim.* 19, 647-50 (1950).—Obituary, with list of publications and portrait. N. Thon

1951

CA DUBININ, M.M.

Sorption and structure of active carbons VIII. Structure of active carbons obtained by using inorganic activating substances. M. M. Dubinin and E. D. Zaverina (Acad. Sci. U.S.S.R., Moscow). *Zhur. Fiz. Khim.* 24, 470-8(1950); cf. *C.A.* 44, 2819e and preceding abstr.—Carbons, prepd. by heating sucrose (1 part) with $ZnCl_2$ (r parts) at 600° for 1 hr. and washing with 3 N HCl and then with H_2O, adsorbed benzene at 20° according to the isotherm $\log a = C - D[\log(p_0/p)]^2$ (cf. *C.A.* 44, 1300d) as long as r was less than 0.4, and according to the isotherm $\log a = M - N\log(p_0/p)$ as long as r was greater than 1. Thus, the ratio r has an effect similar to that of wt. loss in carbons prepd. by heating in CO_2. However, the yield (25-35%) of C activated by $ZnCl_2$ is, e.g., 15 times that obtained in activation by CO_2. Activation with $ZnCl_2$ at 880° gave almost identical results. The yield of C in activation with KSCN at 960° was smaller, and almost no C was obtained when heating sucrose with K_2CO_3 at 850°. Birch wood heated with $ZnCl_2$ yielded C of the first type when r was 0.5 or 1, and of the 2nd type when r was 2, 3, or 5. The vol. of the adsorption space increased with r (for sucrose C), e.g., from 0.04 to 1.6 cc./g. when r increased from 0.04 to 5. For birch charcoal, when r increased from 0.5 to 5, adsorption of PhOH and methylene blue from H_2O increased slightly, but adsorption of Congo red increased greatly showing that, at great r, the pores are accessible to colloid particles also.

J. J. Bikerman

CA DUBININ, M. M.

Sorption and structure of active carbon. IX. *Adsorption of gases by active charcoals.* M. M. Dubinin and E. D. Zaverina (Acad. Sci., Sect. Chem. Sci., Moscow). *Zhur. Fiz. Khim.* 24, 1262-72(1950); cf. *C.A.* 44, 8196a.—The equations: $a = (W_0/v) \exp[-BT^2(\log p/p_s)^2/\beta^2]$ (1) and $W = W_0 \exp(-k\varepsilon^2/\beta^2)$ (2) were derived (*C.A.* 44, 12034d) from Polanyi's theory and verified (*C.A.* 42, 8306e, 8309d; 43, 6037c) for a series of vapors adsorbed on charcoals of the 1st structural type (i.e. with relatively shallow micropores). The symbols mean: W and W_0 = adsorption space and its limiting value (cc./g.); β = a scale factor (= 1 for the standard substance, benzene); B = a const. detd. by the pore-size distribution; a = the amt. adsorbed (millimol./g.); p/p_s = the equil. relative pressure; ε (cal./M) = the adsorption potential; v = mol. vol. of the liquefied vapor. The aim of the present work is to verify the potential theory for the case of the adsorption of gases (above the crit. temp.). Berenyi's extension of Polanyi's theory (*C.A.* 14, 2436) is thus used in order to det. the adsorption isotherm from (2) and from Berenyi's equations $\varepsilon = 4.57\, T \log (31.6\, T/bp)$ (3) and $W = ab$ (4), where p is the gas pressure (mm.) and b the van der Waals const. (cc./millimol.). The gas chosen is ethylene, for which $b = v/4 = 4.31$. Adsorption is measured at 20°, between 1 and 400 mm. on 12 charcoals of 3 origins, activated to various extents in CO_2. Substitution of (3), (4), and numerical values into (2) gives: $\log a = K - F[\log (2.12 \times 10^6/p)]^2$ (5), where $K = \log (W_0/b)$ (6) and $F = 0.05\, kT^2/\beta^2$ (7). The adsorption isotherm (5) is verified by plotting the exptl. data in a $\log a$, $(\log 2.12 \times 10^6/p)^2$ diagram; straight lines are obtained which fit the data between p_1 and p_2: p_1 = 1, 5, 10, 20, 75, or 100 depending on the charcoal, p_2 = 400 for all samples. Benzene adsorption is also measured at 20° on the same samples in order to det. W_0 and B from equation (1). Then, from the value of B and from $k = B/(2.30\, R)^2 = B/20.75$, k is detd.; from k and (7) β for ethylene is obtained. The values of β for the different samples are scattered (±11%) around a mean value 0.54. This is in satisfactory agreement with the theoretically estd. value of $\beta = (P_{C_2H_4}/P_{C_6H_6}) = 0.49$, where P is the parachor (*C.A.* 44, 7815h). From K, the value of W_0 is also detd. and compared to W_0 as detd. from benzene adsorption: the ratio of the two values for the different samples oscillates between rather wide limits (±15%). The agreement with the theory is thus good but only semiquant., owing to the approximations involved in (3) and (4). M. Boudart

Adsorption of gases by active carbons. M. M. Dubinin and K. D. Zaverina. *Doklady Akad. Nauk S.S.S.R.* 72, 319-22(1950).—The equation of the adsorption isotherm applicable to active carbons of the 1st structural type, i.e. with relatively fine micropores, $a = (W_0/v) \cdot \exp.[-B(T^2/\beta^2) \log (p/p_s)^2]$, where W_0 = limiting vol. of the adsorption space, v = mol. vol. of the liquefied gas, and the concomitant equation $W = W_0 \exp.[-k(\epsilon^2/\beta^2)]$ relating the occupied vol. W of the adsorption space and the adsorption potential ϵ, were tested by the linearity $\log a = K - F [\log (31.4\ T/bp)]^2$, where $K = \log (W_0/b)$ and $F = 9.05\ kT^2/\beta^2$. This relation is derived from the above adsorption isotherm with the aid of Berenyi's (*C.A.* 14, 3436) relations W (cc./g.) = ab (where b = van der Waals' const.) and ϵ (cal./mole) = $4.57\ T \log (31.4\ T/bp)$. The linearity between $\log a$ and $[\log (31.4\ T/bp)]^2$ is confirmed for 3 types of C (from sugar, wood, and coal) of moderate activation (loss not over 60%), in the adsorption of C_2H_4 and of C_6H_6 vapor at 20°. From the graphically detd. const. B, the coeffs. k were calcd. by $k = (B/2.30\ R)^2 = (B/20.73)$. With the value $b = 4.33 \times 10^{-2}$ l./mole (from the crit. d.), the linearized adsorption isotherm equation for C_2H_4 becomes $\log a = K - F [\log (2.12 \times 10^6/p)]^2$, with a in millimoles/g. and p in mm. Hg; it holds from 5-10 to 400 mm. Hg (upper limit of the expts.). From the consts. F for C_2H_4 and b for C_6H_6, the affinity coeff. β (ratio of ϵ of C_2H_4 and of C_6H_6 at equal W) is found = 0.54. This checks satisfactorily with $\beta = P/P_0 = 0.49$ calcd. from the parachors P of C_2H_4 and P_0 of C_6H_6.

N. Thon

Methods of studying the structure of highly dispersed and porous bodies; transactions of the conference of June 25-29, 1951.

1. Porosity. 2. Adsorption.

I. Dubinin, Mikhail Mikhailovich, 1901 - ed.

USSR/Chemistry - Adsorption 1 Feb 51

"Investigation of the Adsorption of Benzene Vapor on Activated Carbon Black," Acad M. M. Dubinin, D. P. Timofeyev

"Dok Ak Nauk SSSR" Vol LXXVI, No 4, pp 555-558

Spherical nonporous channel black Spheron Grade 6, on heating in vacuum at 1,000°, was progressively activated at 950° with carbon dioxide by burning off 6.4, 11.3, 21.7, 55.1, and 76.3%. Adsorption isotherms showed that adsorption of 1st type (i.e., adsorption by pore surface of porous carbon) developed in addn to that of 2d

178T21

USSR/Chemistry - Adsorption (Contd) 1 Feb 51

type (by nonporous carbon) as result of activation, proving formation of porous structure.

178T21

VOL'FKOVICH, S.I., akademik, otvetstvennyy redaktor; DUBININ, M.M., akademik, redaktor; KOZLOV, V.V., professor, redaktor; FIGUROVSKIY, N.A., professor, redaktor; BANKVITSER, A.L., redaktor izdatel'stva; MAKUNIN, Ye.V., tekhnicheskiy redaktor

[Dmitrii Ivanovich Mendeleev; his life and works] Dmitrii Ivanovich Mendeleev; zhizn' i trudy. [Moskva] 1957. 254 p. (MLRA 10:2)

1. Akademiya nauk SSSR. Otdeleniye khimicheskikh nauk
(Mendeleev, Dmitrii Ivanovich, 1834-1907)

DUBININ, M. M.

"Surface Properties and Pore Structure of Carbon Adsorbents" (Section 10) a paper submitted at Industrial Carbon and ~~Casphite~~ Graphite Conference, 24-26 Sep57, London.

C-3,800,117

DUBININ, M.M.

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 4012.

Author : M.M. Dubinin.
Inst : Academy of Sciences of USSR.
Title : Letter to The Editor.

Orig Pub: Izv. AN SSSR, otd. khim. n., 1957, No 3, 392.

Abstract: The applicability of the isotherm equation of Dubinin and Radushkevich was established on the basis of a careful experimental determination of adsorption isotherms of C_6H_6 vapors at 20° and of N_2 at -195° on activated carbons (AC) of the 1st structural type. This permits to apply the method of "molecular probes" to the experimental determination of the distribution of AC micropore volumes according to their dimensions, if a set of substances with more or less globular molecules of various dimensions was at hand, because the border volume

Card : 1/2

DUBININ, M.M.

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 4015.

Author : M.M. Dubinin, Ye. D. Zaverina, D.P. Timofeyev.
Inst : Academy of Sciences of USSR.
Title : Adsorption Properties of Carbon Adsorbers. Report 1. Analysis of Earlier Obtained Experimental Data.

Orig Pub: Izv.AN SSSR, Otd. khim. n., 1957, No 6, 670-677.

Abstract: Experimental adsorption data referring to 12 different substances on two activated carbon specimens were analyzed in detail and a good conformity with the experience with the earlier developed potential theory of vapor adsorption on adsorbers with heterogeneous surface was shown. The part of the carbon structure in the adsorption process was made clear and it was shown that in the case of well adsorbed vapors (activity factor $\beta \approx 1.5$), the degree of filling (F) of the micropore

Card : 1/2 -19-

DUBININ, M. M

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13.

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 4014.

Author : B.P. Bering, M.M. Dubinin, Ye. G. Zhukovskaya, A.I. Sakharov, V.V. Serpinskiy.

Inst :

Title : Study of Porous Structure of Solid Bodies by Sorption Methods. III. Gravimetric Methods of Measuring Sorption and Desorption Isotherms of Nitrogen and Benzene Vapors.

Orig Pub: Zh. fiz. khimii, 1957, 31, No 3, 712-716.

Abstract: With a view to select and substantiate the most rational methods of measuring isotherms of vapor sorption (IS) on solid bodies, an improved vacuum installation was constructed; this installation permits reliably to take down the IS of N_2 at a low tempe-rature and the IS of benzene vapors at the room temperature by the gravimetric method. The IS-s determined with the described

Card : 1/2

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 4014.

installation for N_2 at -195° on silica gel and for benzene vapors at 20° on activated carbon coincided practically with corresponding IS-s taken down by the volumetric (N_2) or gravimetric methods by other authors on other installations. (See part II in RZhKhim, 1957, 26362.)

Card : 2/2

-18-

DUBININ, M.M.

DUBININ, M.M.; ZHUK, G.S.; ZAVERINA, Ye.D.

Studies on the porous structure of solids by adsorption methods. Part 4: On the relation between various types of pores in active carbon [with summary in English]. Zhur. fiz. khim. 31 no.5:1126-1135 My '57. (MIRA 10:11)

1. Institut fizicheskoy khimii AN SSSR.
(Carbon, Activated) (Adsorption)

Dubinin, M.M.

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 3995.

Author : B.N. Vasil'yev, B.P. Bering, M.M. Dubinin, V.V. Serpinskiy.
Inst : Academy of Sciences of USSR.
Title : Study of Adsorption Under High Pressure.

Orig Pub: Dokl. AN SSSR, 1957, 114, No 1, 131-134.

Abstract: The CO_2 adsorption on two silica gel specimens in the range from -85 to +40° and under the pressure of from 0 to 85 atm was studied using the instrument described earlier (RZhKhim, 1957, 74788). The adsorption hysteresis loop is observed only in the range from -60 to -20°. The isotherms of -30 and -50° bring to a not coinciding distribution of pore volumes according to their radii. The total substance content a differs noticeably under high pressures from Gibbs' adsorption. It is shown that the mean density ρ_a of CO_2 in the adsorbed state

Card : 1/2

USSR/Physical Chemistry - Surface Phenomena, Adsorption, Chromatography, Ion Interchange. B-13

Abs Jour: Referat. Zhurnal Khimiya, No 2, 1958, 3995.

is greater than the density of a normal liquid (for example, by 14% at 25°). The characteristic curves of the potential adsorption theory depend somewhat on the temperature near t_{cr} (0 and 25°). At the computation of these curves by ν and ς_a, only one and the same curve is obtained for all the temperatures including 0 and 25°. The breaking point observed on the adsorption isosters is explained as an indication of a phase transition of CO_2 in adsorbed state - "two-dimensional crystallization analogue." The capillarily condensed substance in the sorption space is in the state of supercooled liquid down to -85°.

Card : 2/2

LUKYANOVICH, V. M., DUBININ, M. M., LEONT'YEV, Ye. A., SARACHOV, A. I.

"Examination of the Porous Structure of Activated Charcoals."

Paper submitted for presentation at Fourth Int'l Conference on Electron Microscopy, Berlin, GFR, 10-17 Sep 58.

Institute for Physical Chemistry, USSR Acad. Sci. Moscow.

C-3,800,829, 25 Jul 58.

TSITSISHVILI, G. V.; YERMOLENKO, N. F.;

"The adsorption from vapors and liquids."

report presented at the Fourth All-Union Conference on Colloidal Chemistry, Tbilisi, Georgian SSR, 12-16 May 1958 (Koll zhur, 20,5, p.677-9, '58, Taubman, A.B)

DUBININ, M.M., akad.,otv. red.; RAZUMOVA, L.L., red. izd-va.; MARKOVICH, S.M., tekhn. red.

[Methods of studying the structure of highly-dispersed and porous materials; proceedings of the conference] Metody issledovanie struktury vysokodispersnykh i poristykh tel; trudy soveshchaniia. Moskva, Izd-vo Akad. nauk SSSR, 1958. 294 p . (MIRA 11:12)

1. Soveshchaniye po metodam issledovaniya struktury vysokodispersnykh i poristykh tel. 2d, Leningrad, 1956.
(Porosity)
(Adsorption)
(Colloids)

AUTHORS: Dubinin, M. M., Zhukovskaya, Ye. G. 62-58-5-2/27

TITLE: On the Adsorption-Properties of the Carbon-Adsorbents (Ob adsorbtsionnykh svoystvakh uglerodnykh adsorbentov) Communication 2: Investigation of the Adsorption-Properties of Active Coals by Benzene-and Nitrogen-Vapors (Soobshcheniye 2. Issledovaniye adsorbtsionnykh svoystv aktivnykh ugley po param benzola i azota)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk, 1958, Nr 5, pp. 535 - 544 (USSR)

ABSTRACT: As is known, nitrogen-and benzene-vapors are used as standard substances for the investigation and classification of the adsorption-properties of active coals. Up till now, a congruence of the adsorbing properties of active coals above nitrogen-and benzene-vapors has not yet been found, however. The purpose of this work is the investigation of this problem. The adsorbing properties of some samples of active coals above benzene-vapors at 20°C and nitrogen-vapors at -195°C were investigated above all. It was found that in both cases the adsorption depends on the dispersive interaction of the molecules

Card 1/2

On the Adsorption-Properties of the Carbon-Adsorbents. 62-58-5-2/27
Communication 2: Investigation of the Adsorption-Properties of Active Coals by Benezene-and Nitrogen-Vapors

(of the vapors) with the surface of the active coals. The coefficient of affinity of the characteristic nitrogen-curves was calculated. The fundamental causes of the difference of the adsorption-volumina of nitrogen and benzene for the points of the beginning of the hysteresis of the isothermal lines of adsorption were analysed. More rational methods of volume-determination of the micro-and transit-pores (perekhodnyye pory) of active coals were described and substantiated. The problem of the selection of a standardized vapor for the characteristic of the adsorption-properties of active coals was discussed. There are 4 figures, 6 tables and 21 references, 17 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute for Physical Chemistry AS USSR)

SUBMITTED: March 13, 1957

Card 2/2

1. Activated carbons--Adsorptive properties 2. Vapors--Adsorption 3. Benzene--Applications 4. Nitrogen--Applications

AUTHORS: Kadlets, O., Dubinin, M. M. SOV/62-58-9-3/26

TITLE: Investigation of the Kinetics of the Thermal Decomposition of Solid Materials (Issledovaniye kinetiki termicheskogo razlozheniya tverdykh veshchestv) Communication 1: The Thermal Decomposition of Lead Carbonate (Soobshcheniye 1. Termicheskoye razlozheniye uglekislogo svintsa)

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1958, Nr 9, pp 1031 - 1036 (USSR)

ABSTRACT: In the study of the kinetics of the thermal decomposition of solid materials two methods were employed: the gravimetric method and the manometric method. Both methods, however, have deficiencies. The authors therefore investigated the kinetics of the thermal decomposition of solid materials by weighing the gaseous reaction products which were adsorbed onto cooled activated charcoal during the reaction. This method makes measurement at reduced pressure possible, but care must be taken to always maintain a good supply of heat throughout the experiment. The decomposition of the lead carbonate proceeds at a rate proportional to the surface area of the

Card 1/2

Investigation of the Kinetics of the Thermal Decomposition of Solid Materials. Communication 1: The Thermal Decomposition of Lead Carbonate SOV/62-58-9-3/26

undecomposed material (without the auto-catalytic effect of a solid reaction product). The activation energy of the thermal decomposition of the lead carbonate and the factor of the exponential function were calculated. The activation energy was found to be 41 500 cal/mole, while the magnitude of the exponential factor was calculated to be $(0.5 \pm 0.5) \cdot 10^{10}$ $g.cm^{-2}.sec^{-1}$. There are 4 figures, 1 table, and 4 references, 1 of which is Soviet.

ASSOCIATION: Fiziko-matematicheskiy fakul'tet Karlova universiteta v Prage (**Dept.** of Physics and Mathematics of **Charles** University, Prague)

SUBMITTED: April 17, 1958

Card 2/2

AUTHORS: Nikolayev, K. M., Dubinin, M. M. SOV/62-58-10-2/25

TITLE: The Adsorption Properties of the Carbcn Adsorbents (Ob adsorbtsionnykh svoystvakh uglerodnykh adsorbentov) Information 3.- Investigation of the Adsorption Isothermal Lines of Gases and Vapours on Activated Charcoal Within a Wide Temperature Range Including the Critical Range (Soobshcheniye 3. Issledovaniye izoterm adsorbtsii gazov i parov na aktivnykh uglyakh v shirokom intervale temperatur, vklyuchayushchem kriticheskuyu oblast')

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1958, Nr 10, pp 1165-1174 (USSR)

ABSTRACT: As only some of the data worked out in this field contributed to the solution of the problem of the physical adsorption of substances in gas or vapor phase on adsorbents of diverse porous structure, the authors of this paper investigated the wide temperature range including the critical range with respect to the adsorption isothermal lines of nitrogen, krypton, xenon, tetrafluorethylene, and hexafluoropropylene on two types of activated charcoal that belong to the outer members of the series of activated charcoal of the first

Card 1/3

The Adsorption Properties of the Carbon Adsorbents. SOV/62-58-10-2/25
Information 3.- Investigation of the Adsorption Isothermal Lines of Gases and Vapours on Activated Charcoal Within a Wide Temperature Range Including the Critical Range

structural type. As a result of the analysis of the experimental data and the investigation of the properties of the state of the adsorbed substances within the range of critical temperatures the authors proposed rational methods of determining the characteristic adsorption isothermal lines of substances in vapor or gas phase. In agreement with the potential theory of adsorption the coefficients of the affinity of the characteristic curves do not depend on the carbon structure; the volumes of the adsorption space have to be regarded as constant quantities for each activated charcoal if no ultra-porosity effect is present. Equations for the adsorption isothermal lines for the vapor and gas state of the substance to be adsorbed in the phase of equilibrium volumes were proposed for the activated charcoal of the first structural type; these equations correspond to one and the same equation of the characteristic curve. These equations of the adsorption isothermal lines are experimentally founded. There are 9 figures, 2 tables, and

Card 2/3

The Adsorption Properties of the Carbon Adsorbents. SOV/62-58-10-2/25
Information 3.- Investigation of the Adsorption Isothermal Lines of Gases and Vapours on Activated Charcoal Within a Wide Temperature Range Including the Critical Range

23 references, 8 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

SUBMITTED: May 17, 1957

Card 3/3

DUBININ, M., M., akademik

The order of the day is the organization of the amateur-chemists' movement. IUn. tekh. 3 no.11:1-3 N '58. (MIRA 11:12)
(Chemists)

76-32-5-33/47

AUTHORS: Dubinin, M. M., Nikolayev, K. M., Sarakhov, A. I.

TITLE: Using the α-Ionization Manometer in Sorption Investigations (Primeneniye α-ionizatsionnogo manometra v sorbtsionnykh issledovaniyakh)

PERIODICAL: Zhurnal fizicheskoy khimii, 1958, Vol. 32, Nr 5, pp.1155-1159 (USSR)

ABSTRACT: In order to avoid the many disadvantages of mercury manometers in measurements of sorption investigations a variant of the α-ionization manometer was developed under collaboration of the Radium Institute of the AS USSR; this manometer was produced and used in the present investigations. From the diagrams and the description can be seen that radium was used as radioactive source, which was laid in a thin layer on a plate-shaped base of gold, this production having been made by the RIAN of the USSR. The dimensions of the ionization chamber depended on the field of the pressure measurements, with two chambers present for a wide field of pressure (1.10^{-4} to 1000 torr), one for high and another for low

Card 1/2

76-32-5-33/47

Using the α-Ionization Manometer in Sorption Investigations

pressures. A scheme of the amplifier plant which is an alteration of that described by Downing and Mellen (Ref 7) is also given. The described manometer has a measuring sensitivity of 2.o . $1o^{-11}$ A/ torr in the interval from $1.1o^{-2}$ to 15o torr and is calibrated according to an Hg-manometer, with a measuring accuracy of a mean value of 1 - 2 % being achieved. The measurements carried out with nitrogen, krypton xenon and tetrafluorethylene on coal showed, compared with measurements by means of Hg-manometers, a good applicability of the α-ionization manometer for investigations of adsorption phenomena. The described manometer is an experimental apparatus and still has to be further developed. Finally the authors thank Professor V. M. Vdovenko and D. M. Ziv, as well as Ya. Yu. Rib. There are 6 figures and 11 references, 8 of which are Soviet.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii, Moskva (Moscow, Institute of Physics and Chemistry, AS USSR)

SUBMITTED: July 17, 1957

Card 2/2

1. Manometers--Design 2. Alphaparticles--Ionization effects 3. Ionization chambers--Performance

AUTHORS: Dubinin, M. M., Sarakhov, A. I., SOV/ 76-32-6-32/46
Ryabikov, G. N.

TITLE: Methods and Techniques of Physico-chemical Investigations
(Metody i tekhnika fiziko-khimicheskogo issledovaniya)
A Low-Pressure Poremeter (Poromer nizkogo davleniya)

PERIODICAL: Zhurnal fizicheskoy khimii, 1958, Vol. 32, Nr 6,
pp. 1404-1406 (USSR)

ABSTRACT: In order to make possible measurements of pore size in porous materials of 100 μ and less S. A. Semenova (Ref 3) designed an apparatus which, however, has several disadvantages. A poremeter is described which does not have these deficiencies any more; the possibility of investigation in secured at 5 - 1000 torr, i. e. at a pore radius of from 5 to 100 μ. A diagram of the apparatus is given as well as a description of the technique employed. It may be seen that the dilatometer was somehow changed by introducing a chromium-nickel wire, on the other hand the principle of measurement consists of the fact that mercury enters the pores of the sample and that the experiments

Card 1/3

may be carried out within a wide pressure interval of from 30 - 50 torr. In the measurements it must be taken into consideration that also the in-between-space of the sample and of the ampoule is measured; in order to obtain the real values of the porosity special experiments with model substances must be carried out. The dilatometer can be used for low-pressure- as well as for high-pressure-meters. For both measurements the same sample may be used. A diagram of the measurements carried out with the high-pressure instrument of the **PA-4** as compared to those of the described poremeter is given. Finally the authors thank V. V. Serpinskiy. There are 3 figures and 3 references, 3 of which are Soviet.

ASSOCIATION: Akademiya nauk SSSR, Institut fizicheskoy khimii, Moskva (Moscow, Physics Institute, AS USSR)

SUBMITTED: July 17, 1957

Card 2/3

Methods and Techniques of Physicochemical Investigations. A Low-Pressure Poremeter /76-32-6-32/46

1. Materials--Porosity 2. Chemical analysis--Instrumentation

Card 3/3

5(4)

AUTHORS: Moskvitin, N. N., Dubinin, M. M., Academician, Sarakhov, A. I.

SOV/20-122-5-26/56

TITLE: The Adsorption of Water Vapors on Crystalline Powders of Halogenides of Silver and Lead (Adsorbtsiya parov vody na kristallicheskikh poroshkakh galogenidov serebra i svintsa)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol 122, Nr 5, pp 840 - 843 (USSR)

ABSTRACT: The present paper compares the isothermal lines of adsorption on the typical representatives of the crystal groups mentioned in the title for a sufficiently wide temperature interval. The isothermal lines of the adsorption of water vapors were investigated by means of quartz microscales. Preparation of the adsorbents for the experiments is discussed in short. Work with AgJ and AgCl was carried out with red light. The weight of the adsorbents amounted to from 0.75-0.8 g. The isothermal lines of the adsorption of water were measured at 20, 10, 0, and -20° on the crystals of AgJ

Card 1/4

The Adsorption of Water Vapors on Crystalline Powders of Halogenides of Silver and Lead SOV/20-122-5-26/56

and AgCl. All isothermal lines found in this manner (type II according to the classification by Brunauer) are reversible in the entire interval of measured pressures and are fully reproducible at all temperatures. This applies no matter whether the sample had been heated before measurement or not. The heat effect of the adsorption of water has a value similar to that of condensation heat. The isothermal lines of the adsorption of water on AgJ and AgCl are described in the range of relative pressures of 0.05-0.4 by the equation of polymolecular adsorption given by Brunauer, Emmet, and Teller. Next, some characteristic features of the sorption of water on silver iodide and silver chloride are described. Particular interest is caused by the problem of the phase state of the water adsorbed on AgJ and AgCl at temperatures below 0°. Two diagrams show the isosteric lines for various values of adsorption on AgJ and AgCl; they were calculated from the isothermal lines for the temperatures 20, 10, 0

Card 2/4

The Adsorption of Water Vapors on Crystalline Powders of Halogenides of Silver and Lead SOV/20-122-5-26/56

and -20°. All isosteric lines for AgJ consist of 2 linear parts, which intersect in a temperature interval near 0°. The salient points of these curves correspond to the melting of the iron. From the difference between the angles of inclination the value 1450 kcal/mol is obtained for the heat effect of the transition. The isosteric lines of the adsorption of water vapors on AgCl have no salient point. Therefore, the heat effect of the adsorption at positive and negative temperatures is practically equal to the heat of condensation. In the sorption of water on PbJ_2 a non-equilibrium system vapor adsorbent was in all cases concerned. There are 4 figures and 13 references, 4 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

Card 3/4

Dubinin, M. M.

15(6)

AUTHOR: Rebinder, P. A., Academician SOV/30-59-1-5/57

TITLE: New Trends of Colloid Chemistry (Novyye puti razvitiya kolloidnoy khimii)

PERIODICAL: Vestnik Akademii nauk SSSR, 1959, Nr 1, pp 44-51 (USSR)

ABSTRACT: At present, colloid chemistry plays an especially important part in political economy as it is a physical-chemical science concerning substances of modern engineering. It is of great practical importance that at present it is possible to carry on uninterrupted transitions from lyophobic to lyophilic systems. Thus, it is possible to obtain technically important substances with the required structural-mechanical properties. The theory of highly molecular substances and their solutions has developed into an independent branch of colloid chemistry. The vitality of modern colloid chemistry is proved by the fact that it produces many new independent branches of science. Further, the author describes the course of the 4th All-Union Conference of Colloid Chemistry which took place in Tbilisi on May 13-16, 1958. It was organized by the Otdeleniye khimiches-

E. M. Natanson (Kiyev) reported on the present state of research in the field of colloid metals.
A. D. Sheludko (Bulgaria) determined theoretically and experimentally the regularities of synaeresis in foams.
M. P. Volarovich with collaborators spoke about the results of examination of water properties and structure of peat by means of radioactive isotopes.
M. Ye. Shishniashvili considered questions of adsorption and chemosorption of electrolytes in colloid dispersion systems.
B. V. Deryagin and his collaborators reported on the development of the electrostatic stability theory as well as the coagulation of dispersion systems, and on the theory of formation and the properties of aerosols.
L. Ya. Kremnev, A. B. Taubman reported on the role of the structural-mechanical barrier as a factor of practical guarantee for a full stabilization of dispersion systems,

Card 3/6

as P. A. Rebinder showed it in his investigations (Ref 1).
V. G. Levich theoretically showed that an increased viscosity of the protective coverings of the stabilizer is sufficient to prevent a coagulation of particles.
[illegible] and his pupils dedicated a series of reports to examinations in the field of structural characteristics.
A. N. Frumkin with collaborators examined new appearances of adsorption in the theory of electrode processes.
B. A. Dogadkin, A. Ya. Korolev discussed questions of adsorptive interaction of active fillers with polymers, as well as of the chemical modification of the surfaces of solid particles (soot).
Ye. Ye. Segalova, P. A. Rebinder and collaborators reported on the clarification of the process of formation of crystallization structure in the hardening of mineral binding agents.
G. M. Bartenev showed that the appearance of high elasticity is connected with the formation of dispersion structure.
L. S. Palatnik (Khar'kov) examined the colloidal state of aging alloys in thin films and massive samples.
Ye. D. Shchukin, V. V. Yudina clarified the theoretical criteria of spontaneous dispersion of solid bodies, especially metals, in surface-active surroundings.

Card 4/6

V. I. Likhtman reported on the appearance of adsorptive plastification of lead and tin at normal temperatures.
L. A. Kazarnovskiy and collaborators examined the influence of rheological properties of printing colors on their behavior in the printing process.
I. R. [illegible] reported on the regulation of crystallization and coagulation structures in the production of best table-butter.

21

5 (4)

AUTHORS: Bering, B. P., Dubinin, M. M., Serpinskiy, V. V.

SOV/62-59-6-5/36

TITLE: Calculation of the Differential Heats of Vapour Adsorption on Active Coal (Vychisleniye differentsial'nykh teplot adsorbtsii parov na aktivnykh uglyakh)

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1959, Nr 6, pp 981-988 (USSR)

ABSTRACT: Besides applying other methods, the differential adsorption heat may thermodynamically be calculated by means of a model of the adsorption interaction and the theory of molecular forces. In a previous paper by the author (Ref 1) it was shown that according to the potential theory of adsorption the differential heat of an adsorption isotherm may be computed by the following equation: $q = Q - \lambda = \alpha RT^2 \left(\frac{\partial \ln h}{\partial \ln a}\right)_T - RT \ln h$ (1). Here Q denotes the total, and q the pure differential adsorption heat, λ the latent vaporization heat, α the thermal coefficient of the spatial extension of the adsorbed substance, a the adsorption, and $h = p/p_s$ the relative pressure. The characteristic curves of the volume distribution for inhomogeneous adsorption surfaces of different

Card 1/3

Calculation of the Differential Heats of Vapour Adsorption on Active Coal SOV/62-59-6-5/36

type, in the present case active coal, on the adsorption range are known from publications. These curves lead to equations for the adsorption isotherms of different structural types.

(Equations 4 and 5) $a = \frac{Wo}{v} e^{-\frac{BT^2}{\beta^2}(\lg h)^2}$ (I) (4)

$a = \frac{Wo'}{v} e^{\frac{AT}{\beta} \lg h}$ (II) (5). Here Wo (Wo') B (A) denote structural characteristics of the adsorbents, β the affinity coefficient, and v the mole volume. Based upon the equations 1 and 4, or 1 and 5, a term for the differential adsorption heat of vapour of different substances on active coal may be set up. For the purpose of facilitating the computation, this equation was established in variable θ (of the filling degree of the micropores). By following this equation the differential adsorption heat at different numerical values θ was computed for a number of substances on a standard adsorbent at different temperatures. Active coal of the type (I) served as standard adsorbent. The

Card 2/3

Calculation of the Differential Heats of Vapour Adsorption on Active Coal SOV/62-59-6-5/36

values obtained for q are given in a table. A figure shows the dependence of Q on θ for normal heptane, hexane, and pentane. In an analogous manner the equation holding for the differential adsorption heat on coal of the second structural type was derived. For the first type computations of the adsorption heats of different hydrocarbons were carried out (Table 2). For this computation it was necessary for the two structural characteristics Wo, B (Wo', A) of the adsorbent, tabular values on the pressure of the saturated vapour, its mole volume, its parachor, and the thermal coefficient of the volume distribution of the substance to be adsorbed to be known. Finally, an approximative calculation method for the differential heat of the alkanes on adsorbents of the first structural type was worked out. There are 1 figure, 2 tables, and 12 references, 10 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

SUBMITTED: October 24, 1957

Card 3/3

5.4100

77059
SOV/62-59-12-3/43

AUTHORS: Moskvitin, N. N., Dubinin, M. M., Sarakhov, A. I.

TITLE: Study of Adsorption of Water Vapors on Ionic Crystals. Communication I. Methods and Results of the Study of Water Vapor Adsorption on the Crystals of Silver Iodide and Chloride

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1959, Nr 12, pp 2080-2087 (USSR)

ABSTRACT: The authors studied isotherms of adsorption and desorption of water vapor on crystals of silver chloride and iodide (which can be used as active centers in cloud seeding) for the temperature interval (+20 to -20°). Bering and Serpinskiy microbalance /B. P. Bering, V. V. Serpinskiy, Doklady Akad. nauk SSSR, 94, Nr 3, 497 (1954)_7 (sensitivity $\pm 2.5 \cdot 10^{-7}$ g) provided with a special adjustment to eliminate electrostatic effects /A. I. Sarakhov, Doklady Akad. nauk SSSR, 112, Nr 3, 464 (1957)_7, was used. It allowed one to measure adsorption on 0.7-0.8 g

Card 1/7

Study of Adsorption of Water Vapors on Ionic Crystals. Communication I. Methods and Results of the Study of Water Vapor Adsorption on the Crystals of Silver Iodide and Chloride

77059
SOV/62-59-12-3/43

samples of adsorbents with the specific surface of 0.015 m^2/g. Every sample was preheated on the balance pan at 110-120° for 8-10 hr to desorb the substances adsorbed from the air. All manipulations of silver halides were performed under red light. The obtained isotherms are all of type II of the Brunauer classification (Figs. 1 and 2 show the adsorption isotherms for AgI). The adsorption isotherms for both AgI and AgCl are reversible in the whole interval of measured relative pressures, except for the isotherms at -20°, which are reversible only up to the pressure of vapor saturation at that temperature, i. e., 0.77 mm. Above that pressure, desorption points lie on the curve which is above the adsorption curve, both curves forming a hysteresis loop. Values for specific surface (S) of the powders and for the volume of monomolecular layers (a_m) were calculated from the corrected isotherms (curves 2) for 20°, which were calculated

Card 2/7

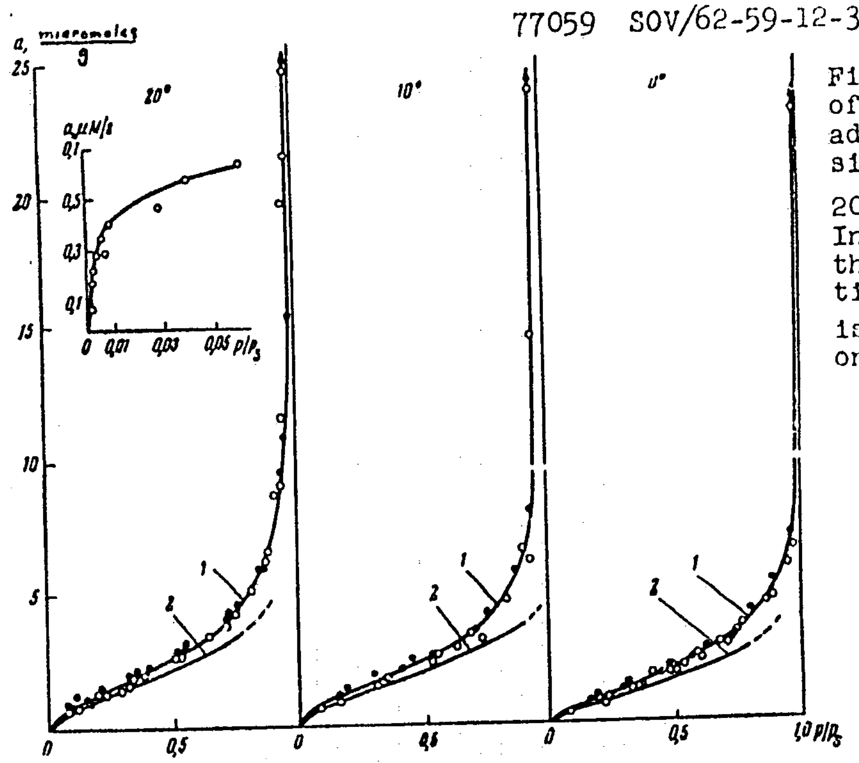


Fig. 1. Isotherms of Water vapor adsorption on silver iodide at 20, 10, and 0°. In the upper left the beginning section of the 20° isotherm is shown on a large scale.

77059 SOV/62-59-12-3/43

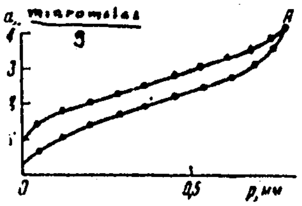


Fig. 2. Isotherm of water vapor adsorption on the crystals of silver iodide at -20°.

from the linear equation of the multimolecular adsorption theory. For AgCl, $a_m = 0.54\ \mu$ moles/g, $S = 0.08\ m^2/g$; for AgI, $a_m = 1.32\ \mu$ moles/g, $S = 0.2\ m^2/g$. Adsorption isoteres of AgI build for the values of a (a = adsorption) from 1.5 to 3.0 μ moles//g (see Fig. 5), and show an inflection at 0°, indicating phase transition at that temperature. The difference in slopes of both linear sections of the curves determines heats of transition (fusion of ice),

Card 4/7

Study of Adsorption of Water Vapors on Ionic Crystals. Communication I. Methods and Results of the Study of Water Vapor Adsorption on the Crystals of Silver Iodide and Chloride

77059
SOV/62-59-12-3/43

which equal 1,450 $\frac{\text{cal}}{\text{mole}}$.

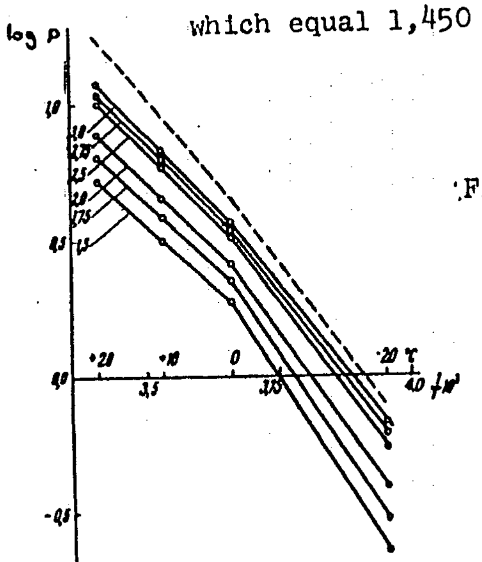


Fig. 5. Isosteres of water vapor adsorption on silver iodide in the temperature interval (20) — (-20°).

Card 5/7

Study of Adsorption of Water Vapors on Ionic Crystals. Communication I. Methods and Results of the Study of Water Vapor Adsorption on the Crystals of Silver Iodide and Chloride

77059
SOV/62-59-12-3/43

Comparison of the isosteres shows that there is no increase of the heat of transition with increasing value of a, indicating that the phase transition does not take place in the total mass of the adsorbed water, but only in the upper adsorption layer. Adsorption isosteres for AgCl do not have this inflection, indicating that all the water, adsorbed on the crystals of AgCl at -20°, is in a supercooled state. This difference--the existence of phase transition in the water adsorbed on AgI, and its absence in water on AgCl--can be connected with behavior difference of these aerosoles when they are used cloud seeding. There are 6 figures; and 18 references, 8 Soviet, 1 German, 1 U.K., 8 U.S. The 5 most recent U.S. and U.K. references are: S. Birstein, J. Meteorol., 12, N 4, 324 (1955); V. Shaefer, J. Meteorol., 11, 417 (1954); E. Fournier, D. Albe, Quart. J. Roy. Meteorol. Soc., 75, N 323, 1 (1949); B. Vonnegut,

Card 6/7

Study of Adsorption of Water Vapors on Ionic Crystals. Communication I. Methods and Results of the Study of Water Vapor Adsorption on the Crystals of Silver Iodide and Chloride

77059
SOV/62-59-12-3/43

J. Appl. Phys., 18, N 7, 593 (1947); W. Patrick, W. Kemper, J. Phys. Chem., 42, 369 (1938).

ASSOCIATION: Institute of Physical Chemistry of the Academy of Sciences, USSR (Institut fizicheskoy khimii Akademii nauk SSSR)

SUBMITTED: April 23, 1958

Card 7/7

5(0)

AUTHORS: Astakhov, K. V., Dubinin, M. M., Chmutov, K. V., Nekrasov, B. V.

SOV/76-33-1-43/45

TITLE: Sergey Aleksandrovich Voznesenskiy (1892-1958) - Obituary (Sergey Aleksandrovich Voznesenskiy (1892-1958))

PERIODICAL: Zhurnal fizicheskoy khimii, 1959, Vol 33, Nr 1, pp 234-237 (USSR)

ABSTRACT: S. A. Voznesenskiy, doctor of chemical sciences and commercial engineer of the first degree, died on August 6, 1958. As a student, Voznesenskiy worked in the laboratory of Professor N. A. Shilov and was occupied with active carbon for gas masks for the elaboration of the method by N. D. Zelinskiy. Later on, Shilov sent him to the kafedra fizicheskoy khimii Moskovskogo vysshego tekhnicheskogo uchilishcha (Department of Physical Chemistry of the Moscow School of Technology) for preliminary study for his professorship.

At the same time he worked at the Moskovskaya sanitarnaya stantsiya (Moscow Sanitary Station). In 1919 he became lecturer for chemirtry at the Penzenskiy institut Narodnogo obrazovaniya (Penza Institute of National Education) but remained in contact with Shilov's laboratory and, together

Card 1/3

Sergey Aleksandrovich Voznesenskiy (1892-1958)- SOV/76-33-1-43/45
Obituary

with Shilov, he published papers in Trudy Rossiyskogo nauchno-issledovatel'skogo khimicheskogo instituta (Reports of the Russian Scientific Research Institute of Chemistry) in 1921. In the same year he became lecturer at the Department of Physical Chemistry of the Moscow School of Technology and in 1923 he went to Berlin and worked with Professor **Freundlich.** In 1927 he was sent to Ruhr-Westfalen in order to investigate sewage purification plants and in 1927 he participated in the Bunsen Congress of Chemists. In 1927 Voznesenskiy became lecturer at the kafedra kolloidnoy khimii (Chair **of** Colloidal Chemistry) and in 1929 professor and chairman of the kafedra analiticheskoy khimii MVTU (Chair of Analytical Chemistry of the MVTU). After the death of N. A. Shilov in 1930, he also became the chairman of the kafedra neorganicheskoy khimii (**Chair** of Inorganic Chemistry). In 1932 the khimicheskiy fakultet MVTU **(Department of Chemistry)** was converted into the Voyennaya akademiya khimicheskoy zashchity (Military Academy of Chemical **Defense**) and Voznesenskiy kept his post.

Card 2/3

Sergey Aleksandrovich Voznesenskiy (1892-1958)- SOV/76-33-1-43/45
Obituary

From 1921 - 1941 Voznesenskiy directed the Laboratory of Water Purification at the Institute "Vodgeo". In 1955 he became professor and head of a chair at the Ural'skiy politekhnicheskiy institut (Urals Polytechnical Institute). He was one of the first to point out the fluoro-organic compounds and wrote a monograph on "The Chemistry of Fluorine". In conclusion, an enumeration of the works by S. A. Voznesenskiy is given, divided into inorganic chemistry, physical and colloidal chemistry and water-technology. There are 1 figure and 65 references, 56 of which are Soviet.

Card 3/3

DUBININ, M. M.

"On The Formation Of Porous Structure In Carbon Activation."

report submitted for 4th Intl. Symposium on the Reactivity of Solids, Amsterdam, 30 May - 4 June 1960.

5.4400

78056
SOV/62-60-1-2/37

AUTHORS: Moskvitin, N. N., Dubinin, M. M., Sarakhov, A. I.

TITLE: Investigation of Steam Adsorption on Ionic Crystals. Communication 2. Nonequilibrium Sorbtion of Water on Crystals of Lead Iodide

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1960, Nr 1, pp 9-14 (USSR)

ABSTRACT: Nonequilibrium sorbtion isotherms of water vapor on PbI_2 crystals (specific surface about 0.2 m^2/g) in temperature range of 20 to -20^{o} were obtained and studied. The experiments were conducted according to the method described by the authors in Izv. AN SSSR. Otd. khim. n. 1959, 2080. The data obtained are shown in Figs. 1, 2, 3, and 4. The following conclusions were made: The sorption isotherms, in the above intervals of pressure, are irreversible. The process of steam sorption on PbI_2 is of a long duration, especially at positive

Card 1/2

Investigation of Steam Adsorption on Ionic Crystals. Communication 2. Nonequilibrium Sorbtion of Water on Crystals of Lead Iodide

78056
SOV/62-60-1-2/37

temperatures (equilibrium was not established during 35 days at 20°). No connection was found between the absorption behavior of PbI_2 and the properties of its aerosol particles in the seeding of supercooled clouds. There are 4 figures; and 16 references, 9 U.S., 7 Soviet. The 5 most recent U.S. references are: E. Ballou, C. Ross, J. Phys. Chem., 57, Nr 7, 653 (1953); R. Beebe, G. Kington, M. Polley, W. Smith, J. Am. Chem. Soc., 72, 40 (1950);J. Van Voorhis, R Graig, F. Bartell, J. Phys. Chem., 61, 1513 (1957); S. Birstein, J. Meteor., 12, Nr 4, 324 (1955); W. Patrick, W. Kemper, J. Phys. Chem., 42, 369 (1938).

ASSOCIATION: Institute of Physical Chemistry of the Academy of Sciences USSR (Institut fizicheskoy khimii Akademii nauk SSSR)

SUBMITTED: April 23, 1958

Card 2/2

DUBININ, M. M.

"Modern Chemical Weapons Are Weapons of Mass Destruction."

report submitted for the 6th Pugwash Conference on Disarmament & World Security, Moscow 27 Nov-5 Dec 1960.

S/062/60/000/006/013/025/XX
B020/B060

AUTHORS: Dubinin, M. M., Zhukovskaya, Ye. G., and Zaverina, Ye. D.

TITLE: Adsorption Properties of Carbon Adsorbents. Communication 5. Characteristics of Water Vapor Sorption by Active Charcoals in the Field of High Relative Pressures

✓

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1960, No. 6, pp. 966-975

TEXT: The particular form of water-vapor sorption and desorption isothermal lines on active charcoals has been repeatedly studied, especially at the authors' laboratory (Refs. 1 - 5). The main ascent zone of the sorption branch was found to correspond to the isotherm of monomolecular adsorption. The concave form of the isotherm is a consequence of the particular adsorption mechanism of water molecules on the primary adsorption centers - the carbon monoxides on the surface - due to the formation of hydrogen bonds, whereby every adsorbed water molecule becomes a secondary adsorption center. These processes effect a steep

Card 1/4

Adsorption Properties of Carbon Adsorbents.
Communication 5. Characteristics of Water
Vapor Sorption by Active Charcoals in the
Field of High Relative Pressures

S/062/60/000/006/013/025/XX
B020/B060

ascent of the adsorption branch of the isotherm (Refs. 3, 5). The main object of the work concerned was the study of water vapor sorption by active charcoals with different porous structures in order to clarify the possibility and the conditions of the capillary condensation course of water vapors in the intermediate pores. The investigation was extended to active charcoals with micropores of at most 10 A diameter, whose intermediate porosity was developed to different degrees. From among them, the types Р1-Р5 (R1-R5) were granulated active coals from vegetable substances, Г1-Г4 (G1-G4) granulated active coals from fossils, and АУ-10-АУ14 (AU-10 - AU-14) active coals with developed intermediate porosity; they are described and thoroughly examined in Ref. 8. For the first two types, the sorption and desorption isothermal lines of benzene vapors were examined at 20° and at pressures of $1 \cdot 10^{-5}$ to 1 at, while for the latter mentioned, the sorption and desorption isothermal lines of benzene vapors were examined at 20°, and those of nitrogen at -195° (Ref. 8). The adsorption apparatus is accurately described in Ref. 9. Calculated volumes

Card 2/4

Adsorption Properties of Carbon Adsorbents. Communication 5. Characteristics of Water Vapor Sorption by Active Charcoals in the Field of High Relative Pressures

S/062/60/000/006/013/025/XX
B020/B060

of intermediate pores and micropores in active coals are indicated in Table 1. The method of the sorption balance was used in the study of water vapor isothermal lines at 20°. Sorption and desorption isothermal lines of the types R2, R1, R3, and R4 (Fig. 1) exhibit a distinct change of the slope of the isotherm branches after the section of the steep ascent, and, more precisely, they exhibit a sharper slope and in the region of high pressures a hysteresis loop covering a large zone. The isothermal lines of the types G3, G4, and R5 (Fig. 2) are shifted toward higher relative pressures; the zone of the hysteresis loop is fairly large and extends over almost the whole isotherm. The critical sorption volumes of active charcoals are intercompared for benzene and water. Calculated sorption volumes of water in micropores of active charcoals are compared with the volumes of coal micropores in Table 3. Table 4 gives data derived from Ref. 8 concerning the volumes of micropores and intermediate pores of active charcoals. Table 5 shows the distribution of the volume of sorbed water between micropores and intermediate pores in critical sorption.

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Card 3/4

Adsorption Properties of Carbon Adsorbents. Communication 5. Characteristics of Water Vapor Sorption by Active Charcoals in the Field of High Relative Pressures

S/062/60/000/006/013/025/XX
B020/B060

Figs. 3 - 6 illustrate the sorption branches of the sorption isothermal lines of nitrogen vapors at -195° and of water at 20° for typical active charcoal specimens. There are 6 figures, 5 tables, and 13 references: 12 Soviet and 1 US.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

SUBMITTED: December 13, 1958

Card 4/4

S/062/60/000/009/002/021
B023/B064

AUTHORS: Ganichenko, L. G., Dubinin, M. M., Zaverina, Ye. D., Kiselev, V. F., and Krasil'nikov, K. G.

TITLE: Study of the Vapor Adsorption on Adsorbents With Heterogeneous Surface. Communication 2. Experiments With Organically Substituted Silica Gel

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1960, No. 9, pp. 1535-1543

TEXT: The adsorption of various vapors on methylated course-porous silica gel and a demethylated sample obtained therefrom is discussed here. The conditions of investigation were chosen in such a way that an essential change of the specific surface seemed to be unlikely. Coarse-porous commercial silica gel KCK(KSK) was taken as initial sample and carefully purified from iron and other impurities. To methylate the surface, silica gel was repeatedly treated with dichloro dimethyl silane vapors at 200°C. Then, the vapors were sucked off in vacuum at 100°C, and silica gel washed with water until the reaction for the chlorine ion was negative. The

Card 1/3

Study of the Vapor Adsorption on Adsorbents With Heterogeneous Surface. Communication 2. Experiments With Organically Substituted Silica Gel

S/062/60/000/009/002/021
B023/B064

silica gel thus obtained is called C-1 (S-1). A portion of silica gel S-1 was treated with nitric acid vapors at 200°C for 6 h. Thus, the organic part of the surface was oxidized, the CH_3 radicals substituted by OH groups, and the methylated silica gel with hydrophobic properties became hydrophilic. This specimen was called C-2 (S-2). The composition of the surface of silica gel S-1 and S-2 was determined by an organic analysis. The analysis was carried out at the same time as the determination of the weight losses in calcination at 1250°. Table 1 shows the analytical results. It may be seen that the demethylation of the surface leads to an increase of its degree of hydration. The specific surface of the specimen changed by 3%. Nitrogen, cyclohexane, benzene, and water were used as adsorbates. Figs. 1-4 show the sorption branches of the adsorption isothermal lines of the vapors of these substances. In all cases, the isothermal lines for S-1 are lower than those for S-2. Table 2 gives a comparison among the specific sorption volumes. The authors explain their results with the help of the respective published data. Summing up: 1) The

Study of the Vapor Adsorption on Adsorbents With Heterogeneous Surface. Communication 2. Experiments With Organically Substituted Silica Gel

S/062/60/000/009/002/021
B023/B064

substitution of one part of the hydroxyl groups of the silica gel surface by methyl groups leads to a reduction of its adsorptive power toward substances in the vapor phase, and to an increase of the molecular fields in the occupied monomolecular layers. 2) To determine the specific surfaces of the adsorbents with a chemically non-homogeneous surface (on the basis of the equation by Brunauer, Emmett, and Teller for the adsorption isothermal line), it is necessary to select the adsorbates with special care. They should be as little sensitive as possible to the chemical heterogeneity of the surface. L. N. Kurbatov is mentioned. There are 5 figures, 4 tables, and 32 references: 22 Soviet, 2 US, 1 British, 6 German, and 1 Swiss.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR). Moskovskiy gosudarstvennyy universitet im. M.V.Lomonosova (Moscow State University imeni M. V. Lomonosov)

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SUBMITTED: April 2, 1959

Card 3/3

84849

S/062/60/000/010/002/018
B015/B064

26.2153
5.1190 (1231 only)

AUTHOR: Dubinin, M. M.

TITLE: Investigation of the Adsorption of Vapors on Adsorbents With Heterogeneous Surfaces. Information 3. Analysis of Experimental Data on Silica Gels With Chemically Modified Surfaces

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye khimicheskikh nauk, 1960, No. 10, pp. 1739-1750

TEXT: A chemical modification of the surfaces of silica gels by substituting the hydroxyl groups of the surface by various radicals changes essentially the adsorptive properties for vapors of organic and inorganic substances. Usually, the adsorptive power decreases with increasing number of substituted OH groups. The Brunauer-Emmett-Teller (BET) equation (1) for the adsorption isothermal line (Ref. 3) can be applied thereto, and the adsorption a_m corresponds to the formation of continuous monomolecular layers. A decrease in the adsorptive power is

Card 1/4

84849

Investigation of the Adsorption of Vapors on Adsorbents With Heterogeneous Surfaces. Information 3. Analysis of Experimental Data on Silica Gels With Chemically Modified Surfaces

S/062/60/000/010/002/018
B015/B064

mostly characterized by a reduction of a_m. Here, the experiments were made with silica gels of different porosity of the types СК (SK), СК-1 (SK-1), СК-2 (SK-2), СМ (SM), СМ-1 (SM-1), СМ-2 (SM-2), С-1 (S-1), and С-2 (S-2); their OH groups were partly replaced by fluorine atoms or CH_3 radicals, and the applicability of the BET equation to the adsorption of various vapors (N_2, Ar, C_6H_{12}, C_6H_6, H_2O) at -195°C (N_2, Ar) and 20°C, respectively, was checked (Table 1). For the majority of the systems investigated, the BET equation is found to hold in the range of relative equilibrium pressure. Owing to the substitution of the OH groups by F-atoms or CH_3 radicals, a_m decreases (less for nitrogen and argon vapors than for cyclohexane, benzene, and water vapors). The change of the adsorptive properties by chemical modification can be determined most conveniently by a graphical determination of the affinity coefficient γ, i.e., by the affinity coefficients of the isothermal lines (Table 2, range of relative equilibrium pressure; Table 3, relative changes of the

Card 2/4

84849

Investigation of the Adsorption of Vapors on Adsorbents With Heterogeneous Surfaces. Information 3. Analysis of Experimental Data on Silica Gels With Chemically Modified Surfaces

S/062/60/000/010/002/018
B015/B064

adsorptive power and the values for γ). A change of the porosity of silica gel was found to effect no particular change of a_m for N_2 and Ar, whereas in the case of benzene and cyclohexane a considerable effect is observable (Table 4). To achieve a qualitative explanation of the decrease in the adsorptive power of silica gels due to chemical modification, the constants C of dispersion interaction were computed (Table 5) according to Kirkwood (Ref. 5), the van der Waals radii r of the adsorbed molecules were taken from Tables, and the relative energies of dispersion interaction were determined (Table 6). The change of the values for C and r of the surface groups determining the equilibrium spacings of the adsorbed molecules in the monomolecular layers were found to be the main reason for the reduced adsorptive power of silica gels for vapors of non-polar substances due to the substitution of F-atoms and CH_3 radicals for the OH groups of the surface. The reduction of this adsorptive power increases with substances in which adsorption is controlled by a donor-acceptor

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Card 3/4

84849

Investigation of the Adsorption of Vapors on Adsorbents With Heterogeneous Surfaces. Information 3. Analysis of Experimental Data on Silica Gels With Chemically Modified Surfaces

S/062/60/000/010/002/018
B015/B064

component. The applicability of the BET equation to determine the specific surface of adsorbents is discussed on the basis of a semi-empirical equation (5) for the adsorption isothermal line given by A. V. Kiselev, and the results are given (Table 7). The latter show that the applicability of the BET equation is limited. The author thanks A. V. Kiselev for a discussion. There are 2 figures, 7 tables, and 10 references: 6 Soviet, 3 US, and 1 German.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

SUBMITTED: June 2, 1959

Card 4/4

IVANOV, A.K.; DUBININ, M.M.; KISELEV, V.V.

Screw compressors in the gas industry. Gaz.prom. 5 no.10:40-43 O '60. (MIRA 13:10)

(Compressors)

S/076/60/034/009/015/022
B015/B056

AUTHORS: Dubinin, M. M., Vishnyakova, M. M., Zhukovskaya, Ye. G., Leont'yev, Ye. A., Luk'yanovich, V. M., and Sarakhov, A. I.

TITLE: Investigation of the Porous Structure of Solids by Sorption Methods. V. Application of Different Methods for Studying the Structure of Intermediate and Macro-pores of Active Coals

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 9, pp. 2019-2029

TEXT: A thorough investigation of the structure of intermediate pores, whose size is between micro- and macro-pores, of some typical kinds of coal (from the type АУ-10 - АУ-14 (AU-10 to AU-14)) with intermediate porosity is carried out by the method of capillary condensation of vapors (benzene or nitrogen), by pressing in mercury, or by electron microscopy. Data concerning the volumes of the micro- and intermediate pores of the investigated kinds of coal are given in a table and show that in all

Investigation of the Porous Structure of Solids by Sorption Methods. V. Application of Different Methods for Studying the Structure of Intermediate and Macro-pores of Active Coals

S/076/60/034/009/015/022
B015/B056

samples the volumes of the intermediate pores exceed those of the micropores by a multiple. The sorption and desorption experiments carried out with nitrogen vapors at -195°C and benzene at 20°C a device with quartz scales. A detailed description of this device is given in Ref. 11. The sorption isothermal lines (Figs. 1-3) are all S-shaped and have a hysteresis, the beginning of which corresponds to the equilibrium pressure $(p/p_s)_0 = 0.175$ for benzene at 20°C and $(p/p_s)_0 = 0.45$ for nitrogen at -195°C. For the purpose of determining the porous structure by the method of pressing-in mercury, two pore gauges of the type ПА-4 (PA-4)(Ref. 8) (one for low and one for high pressure) were used. For electro-microscopic examinations a УЭМ-100 (UEM-100) electron microscope was used, carbon replicas were recorded (Fig. 5), and pore diameters from 70 to 110 A were found. The summational curves (Figs. 6-8) of the volume of the intermediate pores with respect to their effective diameters, which were calculated from the sorption isothermal lines for benzene and were measured

Card 2/3

Investigation of the Porous Structure of Solids by Sorption Methods. V. Application of Different Methods for Studying the Structure of Intermediate and Macro-pores of Active Coals

S/076/60/034/009/015/022
B015/B056

by pressing in mercury, showed good agreement. In the case of the results obtained for nitrogen, less good agreement was found. The electron-microscopic values qualitatively confirm the sorption values and the measured values obtained by pressing in mercury. B. P. Bering and V. V. Serpinskiy are thanked for their interest in the present paper. There are 8 figures, 1 table, and 13 references: 12 Soviet and 1 US.

ASSOCIATION: Akademiya nauk SSSR Institut fizicheskoy khimii (Academy of Sciences USSR, Institute of Physical Chemistry)

SUBMITTED: December 24, 1958

Card 3/3