Ozone Reactions in Aqueous Solutions -- A Bibliography
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- Programming Science and Technology — Computer Systems Engineering.

¹Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Washington, DC 20234.
²Some divisions within the center are located at Boulder, CO 80303.
Ozone Reactions in Aqueous Solutions -- A Bibliography

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Center for Chemical Physics
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National Bureau of Standards
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Office of Standard Reference Data
National Measurement Laboratory
National Bureau of Standards
Washington, DC 20234

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, Secretary
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director
Issued August 1983
OZONE REACTIONS IN AQUEOUS SOLUTIONS

-- A BIBLIOGRAPHY

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National Measurement Laboratory
National Bureau of Standards
Washington, DC 20234

A reaction oriented list of references is provided for published papers and reports containing rate data or information on mechanism for reactions of ozone with various substrates in aqueous solutions. Catalyzed, as well as uncatalyzed, reactions are included. One hundred and sixty-four papers are listed. The period covered extends from 1913 to 1981.

Key words: aqueous solution; bibliography; chemical kinetics; decomposition; mechanism; oxidation; ozone; rate constant; reaction.

This bibliography lists papers and reports on the reactions of ozone with various substrates in aqueous solutions. Catalyzed reactions, as well as uncatalyzed reactions, are included.

The first study of ozone reactions in aqueous solutions was performed in 1913 by V. Rothmund and A. Burgstaller, who studied the rate of decomposition of ozone in water. In 1917 the same authors studied the reaction between ozone and hydrogen peroxide. The study of ozone decomposition in water was continued by F. Kawamura (1932), K. Sennewald (1933), F. Weiss (1935), W. C. Bray (1938), and H. Taube and W. C. Bray (1940). H. Taube examined the reactions of ozone with formic acid (1941), with bromide ion (1942) and chloride ion (1949). Ozone decomposition was studied again by M. C. Alder and G. R. Hill (1950), W. Stumm (1954), E. Abel (1955), and Kilpatrick et al. (1956), while E. Abel studied also the reaction of ozone with hydrogen peroxide. Since 1970 there has been a large increase in the number of papers published in this subject area. The present bibliography includes 164 papers and reports dealing with such reactions. The period covered extends from 1913 to 1981.
ARRANGEMENT OF THE REPORT

This bibliography is in two parts:

Part I. Guide to data contained in references. Each entry consists of a reference code and a property code. These are discussed below.

Part II. References

Ordering of Entries

In both parts of this report, entries are ordered chronologically beginning with the earliest papers and within each year alphabetically by author's name.

Reference Code

Each paper or report included in Part I is indicated by a brief reference code consisting of a string of characters showing:

1) Year of publication (last two digits)
2) Author or first two authors, using the first three letters of each last name (patronymic). When two names are present they are separated by a slash.
3) If necessary, a digit is added to distinguish among papers that would have the same code according to rules (1) and (2).

Examples:

42 TAU
70 SHA/KOZ
72 IVA/NIK
72 IVA/NIK2

The total length of the string, including the digit, may be no longer than 11 characters. A code without added digit has, implicitly, the digit 1 associated with it.

Property Code

The property code follows the reference code for each entry in Part I. The code consists of abbreviations which are used for data flagging. In this publication only the following listed four abbreviations are used for data flagging:

Dec (Decomposition)
Mec (Mechanism)
RR (Reaction Rate Data as: Rate constant, relaxation time, etc.)
Rxn with: (Reaction with other compounds)

references

Part II includes the same reference codes (or "short references") as Part I, in the same order, followed by the complete reference which gives: the name of author(s), the full title of the paper, and the name of the journal followed by the volume number, page, and year of publication. The full reference format is demonstrated below:

Part I. Guide to Data Contained in References.
For explanation of reference codes and property codes used see Guidelines for the User.

<table>
<thead>
<tr>
<th>Ref Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 ROT/BUR</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>17 ROT/BUR</td>
<td>Rxn with: $\text{H}_2\text{O}_2$; RR</td>
</tr>
<tr>
<td>32 KAW</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>33 SEN</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>34 KAW</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>35 WEI</td>
<td>Dec, Rxn with: $\text{H}_2\text{O}_2$; RR</td>
</tr>
<tr>
<td>37 VAS/KAS</td>
<td>Rxn with: $\text{SO}_2 + \text{H}_2\text{O}$; Mec, RR</td>
</tr>
<tr>
<td>38 BRA</td>
<td>Rxn with: $\text{H}_2\text{O}_2$; RR</td>
</tr>
<tr>
<td>40 TAU/BRA</td>
<td>Rxn with: $\text{H}_2\text{O}_2$; Mec, RR</td>
</tr>
<tr>
<td>41 TAU</td>
<td>Rxn with: $\text{HCOOH}$; Mec, RR</td>
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<tr>
<td>42 TAU</td>
<td>Rxn with: Br$^-$, Mec, RR</td>
</tr>
<tr>
<td>48 HIL</td>
<td>Rxn with: $\text{CO}^{2+}$; Mec, RR</td>
</tr>
<tr>
<td>49 YEA/TAU</td>
<td>Rxn with: Cl$^-$; RR</td>
</tr>
<tr>
<td>50 ALD/HIL</td>
<td>Dec, Mec, RR</td>
</tr>
<tr>
<td>54 STU</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>55 ABE</td>
<td>Dec, Mec</td>
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<tr>
<td>55 ABE2</td>
<td>Rxn with: $\text{H}_2\text{O}_2$; Mec, RR</td>
</tr>
<tr>
<td>56 KIL/HER</td>
<td>Dec, RR</td>
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<tr>
<td>58 KLE/NAL</td>
<td>Rxn with: $\text{C}_3\text{H}_7\text{OOH}$; RR</td>
</tr>
<tr>
<td>59 KHA/BAR</td>
<td>Rxn with: CN$^-$; RR</td>
</tr>
<tr>
<td>61 SON/DOD</td>
<td>Rxn with: CN$^-$; Mec</td>
</tr>
<tr>
<td>62 HAU/SII</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>65 CON/HAM</td>
<td>Rxn with: Fe$^{2+}$; RR</td>
</tr>
<tr>
<td>67 LUN/KUS</td>
<td>Rxn with: $\text{NO}_2^-$, SeO$_3^{2-}$, AsO$_3^{3-}$, PO$_3^{3-}$, Ag$^+$, Mn$^{2+}$; Mec</td>
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<tr>
<td>67 WAG/ECK</td>
<td>Rxn with: Cu$^{2+}$</td>
</tr>
<tr>
<td>68 CZA/SAM</td>
<td>Dec, RR</td>
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<tr>
<td>68 EIS</td>
<td>Rxn with: C$_6$H$_5$-OH; Mec</td>
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<tr>
<td>68 GRI/SHA</td>
<td>Rxn with: N$_2$H$_5$+ salts; Mec</td>
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<tr>
<td>68 ILN/KHE</td>
<td>Rxn with: Pyrenes and Anthracenes</td>
</tr>
<tr>
<td>68 SEN/IKE</td>
<td>Rxn with: Mn$^{2+}$</td>
</tr>
<tr>
<td>70 LUN/FRA</td>
<td>Rxn with: $\text{NO}_2^-$, HPO$_3^{2-}$, SeO$_3^{2-}$; Mec</td>
</tr>
</tbody>
</table>
70 KAN/MOK  Rxn with: cy-C₆H₁₂; Mec
70 ROG  Dec, RR
70 SHA/KOZ  Rxn with Np(VI); RR
71 EIS  Rxn with: C₆H₂OH; Mec
71 NEW/DAV  Dec, RR
71 HER/LOV  Dec, RR
71 ROG  Rxn with: (CH₃)₂NH
71 SHE/MAR  Rxn with: Phosphnamide
71 VYA/DAV  Rxn with: Pu(IV)
72 BAL/SEL  Rxn with: CH⁻; RR
72 DON/ENR  Rxn with: Carbon black; Mec
72 GOU  Rxn with: C₆H₂OH; RR, Mec
72 IVA/NIK  Dec, RR, Mec
72 IVA/NIK2  Rxn with: Ce³⁺, Ag⁺; RR, Mec
72 KRI/MUR  Rxn with: [Re(en)₂O₂]⁺; RR
72 PEN  Rxn with: SO₂, NO₂, H₂S; RR
72 RAZ/GLO  Rxn with: C₆H₂OH; RR
72 VYA/DAV  Rxn with: Pu(IV); RR
73 DUD  Rxn with: Br⁻
73 GOR/BAS  Rxn with: CH₃COCH₃
73 GOR/GOR  Rxn with: CH₃COCH₃; Mec
73 GOR/KOZ  Dec, RR, Mec
73 GOR/KOZ2  Dec, RR, Mec
73 GOR/VOD  Dec, Rxn with: RH, ROH, RCHO, R₂CO, etc.
73 KAN/MOK  Rxn with: cy-C₅H₁₀
73 SHA/VYA  Rxn with: Ce³⁺; RR, Mec
73 SHE  Rxn with: I⁻
73 TAK/OKU  Rxn with: Na₂S₂O₃; Mec
74 GER/KUR  Rxn with: CH₃CH₂COCH₃; RR
74 GIL  Rxn with: mono-, and poly-Chlorophenols
74 GOR/BAS  Rxn with: Ag⁺; RR, Mec
74 GOR/KOZ  Dec, RR, Mec
74 KON/GER  Rxn with: CH₃CH₂COCH₃; RR, Mec
<table>
<thead>
<tr>
<th>Code</th>
<th>Reaction with:</th>
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<td>74 PAK/KRA</td>
<td>$\text{CH}_3\text{OH, CH}_3\text{CH}_2\text{OH, C}_6\text{H}_9\text{OH, C}<em>6\text{H}</em>{17}\text{OH}$</td>
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<td>74 SHU/NIK</td>
<td>$\text{Ru(III), Ru(IV)}$</td>
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<td>74 ZAM/KUN</td>
<td>$\text{C}_6\text{H}_5\text{OH}$</td>
</tr>
<tr>
<td>75 CHT/AKO</td>
<td>$\text{W, }\text{W}_2\text{S}_2$</td>
</tr>
<tr>
<td>75 CHU/KOK</td>
<td>$\text{Pb(NO}_3\text{)_2}$</td>
</tr>
<tr>
<td>75 GOR</td>
<td>Dec</td>
</tr>
<tr>
<td>75 KOC/MEJ</td>
<td>$\text{Sulfonates and Sulfates}$</td>
</tr>
<tr>
<td>75 KUR/SAK</td>
<td>$\text{Tryptophan}$</td>
</tr>
<tr>
<td>75 LYS/ATY</td>
<td>$\text{(CH}_3\text{)_2NNH}_2, \text{Mec}$</td>
</tr>
<tr>
<td>75 MAT/FUJ</td>
<td>$\text{CN}^-, \text{RR}$</td>
</tr>
<tr>
<td>75 NIK/IVA</td>
<td>$\text{Np}^{4+}, \text{Pu}^{4+}, \text{RR, Mec}$</td>
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<tr>
<td>75 TAR/MAR</td>
<td>$\alpha-\text{Naphthol}$</td>
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<tr>
<td>75 TYU/YAK</td>
<td>$\text{Sulfates, Pyridines, Pyrazoles, Nicotinic Acid; RR, Mec}$</td>
</tr>
<tr>
<td>75 VEB/GAE</td>
<td>$\text{Acrylonitrile}$</td>
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<tr>
<td>76 CHU</td>
<td>$\text{Sn}^{2+}$</td>
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<tr>
<td>76 CHU/MAS</td>
<td>$\text{NCS}^-$</td>
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<tr>
<td>76 HOI/BAD</td>
<td>$\text{Benzene, o-Xylene, Styrene, Aniline, Phenols, Alcohols; RR}$</td>
</tr>
<tr>
<td>76 JOY</td>
<td>$\text{Arylsulfonic acids}$</td>
</tr>
<tr>
<td>76 KHE/DUD</td>
<td>$\text{Br}^-$</td>
</tr>
<tr>
<td>76 PEL</td>
<td>Dec</td>
</tr>
<tr>
<td>76 TOZ/NIS</td>
<td>$\text{As(III)}$</td>
</tr>
<tr>
<td>77 CHE/LEB</td>
<td>$\text{Ce(III), Bk(III)}$</td>
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<tr>
<td>77 ERI/YAT</td>
<td>$\text{SO}_2; \text{RR, Mec}$</td>
</tr>
<tr>
<td>77 GAL/GAL</td>
<td>$1-(p-\text{Nitrophenyl})-2-\text{acetylamino}-1,3-\text{propanediol}$</td>
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<tr>
<td>77 GLI</td>
<td>$\text{Maleic acid, Fumaric acid, Glyoxylic acid, Formic acid, Oxalic acid}$</td>
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<tr>
<td>77 GLA/TOM</td>
<td>$\text{aromatic amines, sulfanilic acid}$</td>
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<tr>
<td>77 GOB/CHU</td>
<td>$\text{Br}^-, I^-, \text{RR, Mec}$</td>
</tr>
<tr>
<td>77 GOR/SIM</td>
<td>$\text{CH}_3\text{CH}_2\text{COCH}_3, \text{Mec}$</td>
</tr>
<tr>
<td>77 KOV/YAV</td>
<td>$\text{Na}_2\text{S; RR}$</td>
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<tr>
<td>77 KUO/LI</td>
<td>Dec, RR</td>
</tr>
<tr>
<td>77 PRE/MAU</td>
<td>$\text{C}_6\text{Cl}_9\text{OH, C}_6\text{H}_4\text{Cl}_2, C_4\text{H}_5\text{Cl}_2, \text{CHCl}_3, \text{Chlorinated biphenyls}$</td>
</tr>
<tr>
<td>77 RIZ/AUG</td>
<td>$\text{C}_6\text{H}_5\text{OH; RR}$</td>
</tr>
<tr>
<td>77 SHA/YAK</td>
<td>$\text{Cumene}$</td>
</tr>
</tbody>
</table>
77 TAR/MAR Rxn with: S-ethyl-N,N-di-n-propylthiocarbamate
77 TAR/MAR2 Rxn with: Zinc dimethylthiocarbamate and tetramethylthiuram disulfide
77 T/YU Rxn with: Alkylpyridines
77 T/YU/YAK Rxn with: Alkylpyridines and Alkylpyrazoles; Mec
77 YOC Rxn with: Styrene
78 A/U2/RIZ Rxn with: C6H5OH; RR
78 A/U2/RIZ2 Rxn with: C6H5OH; RR, Mec
78 CHU Rxn with: Pd2+, Pt2+
78 GIL Rxn with: Aliphatic and aromatic acids, cresols, glyoxal
78 H0I/BAD Rxn with: NH3; RR
78 I/S/DOB Rxn with: Alcohols, Phenols, Cyanohydrins, Amines, Aromatic amines, Benzothiazole
78 J/OY/GIL Rxn with: Alkylbenzenesulfonic acids
78 K/AS/MAT Rxn with: CN⁻; RR
78 L/R/HOR Rxn with: SO2; RR, Mec
78 M/OR/IK Rxn with: Organic compounds (Review)
78 ONA Rxn with: Azo Dyes; RR, Mec
78 PRA Rxn with: Br⁻
78 P/R/E/HAV Rxn with: Pesticides (Malathion, Baygon, Vapam, DDT)
78 S/HA/KOL Rxn with: Caffeine
78 S/KU Rxn with: Sodium Alkylbenzenesulfonates
78 S/KU2 Rxn with: Sodium Alkynaphthalenesulfonates
78 S/zu/IIZ Rxn with: Polyacrylamide
78 YAK/DNE Rxn with: I⁻, Mn²⁺; RR
78 YOC Rxn with: Styrene, Bromobenzenesulfonic acid
79 B/E/L Rxn with: CH₃COCH₃
79 D/G/BRAS Rxn with: C₂H₅OH; RR, Mec
79 H/AR/BO Rxn with: Ethylenediamine
79 N/AK/NAK Dec, RR
79 R/AZ/DOE Rxn with: OH⁻; RR, Mec
79 S/TE/BEN Rxn with: Water-soluble organic substances, Nitroaniline
79 SUL/ROT Rxn with: Water-soluble polymers; RR
79 SUZ/TAU Rxn with: C₆H₅OH, Hydroquinone, Na 1-anthraquinone, Na Benzenesulfonate, Phthalic acid, Bromobenzenesulfonic acid
79 YAK Rxn with: C₆H₅OH, Hydroquinone, Na 1-anthraquinone, Na Benzenesulfonate, Phthalic acid, Bromobenzenesulfonic acid
80 DUG/JAU Rxn with: Glycine; RR
80 GIL Rxn with: trans-trans Muconic acid; RR, Mec
80 HUA Rxn with: 2,2',4,4',6,6'-Hexachlorobiphenyl; RR, Mec
80 JOY/GIL Rxn with: p-Toluenesulfonic acid; Mec
80 KER/TAR Rxn with: Azobenzene
80 KIR/LIT Rxn with: Ethyl mercaptan
80 LIB/BOS Rxn with: I⁻
80 RUT/SZK Rxn with: HCHO
80 SUL Rxn with: Dec, RR
80 SUL/ROT Rxn with: Dec, RR
80 SUZ/MIY Rxn with: Poly(oxyethylene); RR
80 TYU Rxn with: Benzimidazole, benzotriazole, benzopyrazole; RR
80 TUU/BER Rxn with: Alkylpyridines; RR
80 TUU/YAK Rxn with: Mn²⁺, Mn³⁺; RR, Mec
80 ZEE/VIS Rxn with: CN⁻; RR, Mec
81 GUR Rxn with: C₆H₅OH; RR, Mec
81 HAR/TAK Rxn with: Br⁻; RR, Mec
81 LEG/LAN Rxn with: C₆H₅OH, Hydroquinone, Phenoxyacetic acid, Aniline
81 MAR/DAM Rxn with: SO₂
81 MAT/TAK Rxn with: NCO⁻; RR, Mec
81 MBA/MAN Rxn with: Lignin
81 PAN/CHE Rxn with: Methyl β-D-glucopyranoside; RR
81 REU/OVE Rxn with: C₆H₅OH; RR
81 SIE/COW Rxn with: NH₂NH₂, CH₃NHNH₂, (CH₃)₂NNH₂
81 TAK/KAT Rxn with: Dec, RR
81 TER/SUG Rxn with: CN⁻; RR
81 TYU Rxn with: Fe²⁺; RR, Mec
81 TYU/DNE Rxn with: Fe²⁺; RR, Mec
81 YAK Rxn with: CH₃OH, HCHO, HCOOH; Mec
Part II. References

1913

1917

1932

1933

1934

1935

1937

1938

1940

1941
1942

42 TAU Taube, H., "Reactions in Solutions Containing O$_3$, H$_2$O$_2$, H$^+$ and Br$^-$. The Specific Rate of the Reaction O$_3 +$ Br$^-\rightarrow$," J. Am. Chem. Soc. 64, 2468 (1942)

1948


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1971


1972


1975


75 KUR/SAK Kuroda, M., Sakiyama, F., and Narita, K., "Oxidation of Tryptophan In Lysozyme by Ozone in Aqueous Solution," J. Biochem. 78, 641 (1975) (Toyko)


1977


77 ERI/YAT Erickson, R. E., Yates, L. M., Clark, R. L., and McEwen, D., "The Reaction of Sulfur Dioxide with Ozone in Water and Its Possible Atmospheric Significance," Atmos. Environ. 11, 813 (1977)


1978


1979

79 COR/BAS

79 HEA

79 LI/KUO

79 MAR/OBO

79 NAK/NAK

79 RAZ/OVE

79 STE/BEN

79 SUL/ROT

79 SUZ/TAU

79 YAK

1980

80 DUG/JAU

80 GIL

80 HUA

80 JOY/GIL

80 KER/TAR

80 KIR/LIT
Kirchner, K., and Litzenburger, W., "Oxidation of Mercaptan with Ozone in Water and Aqueous Solutions; Significance for Air and Water Purification," DEHEMA—Monogr. 86, 87 (1930) (Ger); Chem. Abstr. 93:172767y (1980)
1980


1981


### Ozone Reactions in Aqueous Solutions--A Bibliography

#### Title and Subtitle

A reaction oriented list of references is provided for published papers and reports containing rate data or information on mechanism for reactions of ozone with various substrates in aqueous solutions. Catalyzed, as well as uncatalyzed, reactions are included. One hundred and sixty-four papers are listed. The period covered extends from 1913 to 1981.

#### Key Words

- aqueous solution
- bibliography
- chemical kinetics
- decomposition
- mechanism
- oxidation
- ozone
- rate constant
- reaction

#### Availability

- Unlimited
- For Official Distribution. Do Not Release to NTIS

#### Additional Information

- Library of Congress Catalog Card Number: 83-600538
- Document describes a computer program; SF-185, FIPS Software Summary, is attached.
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