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A molecular perspective on the cleaning of oil paintings

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BIBLIOGRAPHY

- (1) Learner, T., *Modern Paints Uncovered*, 2007; Vol. 1, p 317.
- (2) Hermans, J. Metal soaps in oil paint : Structure, mechanisms and dynamics., Ph.D. Thesis, University of Amsterdam, 2017.
- (3) Casadio, F; Keune, K; Noble, P; van Loon, A; Hendriks, E; Centeno, S; Osmond, G, *Metal Soaps in Art*; Casadio, F, Keune, K., Noble, P., Van Loon, A., Hendriks, E., Centeno, S. A., Osmond, G., Eds.; Cultural Heritage Science; Springer International Publishing: Cham, 2019.
- (4) Lazzari, M.; Chiantore, O. *Polymer Degradation and Stability* **1999**, *65*, 303–313.
- (5) Van Gorkum, R.; Bouwman, E. *Coordination Chemistry Reviews* **2005**, *249*, 1709–1728.
- (6) Soucek, M. D.; Khattab, T.; Wu, J. *Progress in Organic Coatings* **2012**, *73*, 435–454.
- (7) Van den Berg, J. D. J.; Vermist, N. D.; Carlyle, L.; Holcapek, M.; Boon, J. J. *Journal of separation science* **2004**, *27*, 181–99.
- (8) Baij, L.; Chassouant, L.; Hermans, J. J.; Keune, K.; Iedema, P. D. *RSC Advances* **2019**, *9*, 35559–35564.
- (9) Bay, L.; Burnstock, A.; Lee, J.; Ormsby, B.; van den Berg, K. J. *ICOM-CC 18th Triennial Conference Preprints, Copenhagen, 4-8 September 2017* **2017**, 1302.
- (10) Morsch, S.; Van Driel, B. A.; Van Den Berg, K. J.; Dik, J. *ACS Applied Materials and Interfaces* **2017**, *9*, 10169–10179.
- (11) Chung, J.; Ormsby, B.; Lee, J.; Burnstock, A.; van den Berg, K. J. *ICOM-CC 18th Triennial Conference Preprints, Copenhagen, 4-8 September 2017* **2017**.
- (12) Silvester, G.; Burnstock, A.; Megens, L.; Learner, T.; Chiari, G.; van den Berg, K. J. *Studies in conservation* **2014**, *59*, 38–51.
- (13) Banti, D.; La Nasa, J.; Tenorio, A. L.; Modugno, F.; van den Berg, K. J.; Lee, J.; Ormsby, B.; Burnstock, A.; Bonaduce, I. *RSC Advances* **2018**, *8*, 6001–6012.
- (14) Lee, J.; Bonaduce, I.; Modugno, F.; La Nasa, J.; Ormsby, B.; van den Berg, K. J. *Microchemical Journal* **2018**, *138*, 282–295.
- (15) La Nasa, J.; Lee, J.; Degano, I.; Burnstock, A.; van den Berg, K. J.; Ormsby, B.; Bonaduce, I. *Scientific Reports* **2019**, *9*, 3467.
- (16) Stoner, J. H.; Rushfield, R. A., *The conservation of easel paintings*; Abbingdon, Oxon: New York, 2012, p 889.
- (17) Poli, T.; Piccirillo, A.; Zoccali, A.; Conti, C.; Nervo, M.; Chiantore, O. *Polymer Degradation and Stability* **2014**, *102*, 138–144.

- (18) Keune, K.; Mass, J.; Mehta, A.; Church, J.; Meirer, F. *Heritage Science* **2016**, *4*, 10.
- (19) De la Rie, E. R. *Analytical Chemistry* **1989**, *61*, 1228A–1240A.
- (20) Mills, J.; White, R., *Organic Chemistry of Museum Objects*; Routledge: Oxford, United Kingdom, 2012.
- (21) Sutherland, K. *Studies in Conservation* **2000**, *45*, 54.
- (22) Wolbers, R., *Cleaning Painted Surfaces: Aqueous Methods*; Archetype Publications: London, 2000, p 198.
- (23) Ormsby, B. A.; Soldano, A.; Keefe, M. H.; Phenix, A.; Learner, T. *AIC Paintings Specialty Group Postprints* **2010**, *23*, 1–11.
- (24) Pavitt, R. *Cleaning of Painted Surfaces - Wolbers Strikes Again! - A Workshop Review by Rebecca Pavitt.*, 2012.
- (25) Stolor, N. *Studies in Conservation* **1961**, *6*, 84–88.
- (26) Erhardt, D.; Tumosa, C. S.; Mecklenburg, M. F. In *Tradition and innovation: advances in conservation. Contributions to the IIC Melbourne congress, 10-14 October 2000*, 2000, pp 65–69.
- (27) Moutsatsou, A.; Alexopoulou, A. *Studies in Conservation* **2014**, *59*, 3–9.
- (28) Phenix, A.; Sutherland, K. *Studies in Conservation* **2001**, *46*, 47–60.
- (29) Baij, L.; Hermans, J. J.; Keune, K.; Iedema, P. *Angewandte Chemie International Edition* **2018**, *57*, 7351–7354.
- (30) Khandekar, N. *Studies in Conservation* **2000**, *45*, 10–20.
- (31) Mecklenburg, M. F.; Charola, A. E.; Koestler, R. J. *Smithsonian Contributions to Museum Conservation* **2013**, *3*, 1–243.
- (32) Baij, L.; Keune, K.; Hermans, J. J.; Noble, P.; Iedema, P. D. In *Gels in the Conservation of Art*, ed. by Ormsby, B.; Townsend, J. H.; Wolbers, R., Archetype Publications: London, 2017, pp 316–321.
- (33) Porter, N. A.; Caldwell, S. E.; Mills, K. A. *Lipids* **1995**, *30*, 277–290.
- (34) Porter, N. A.; Weber, B. A.; Weenen, H.; Khan, J. A. *Journal of the American Chemical Society* **1980**, *102*, 5597–5601.
- (35) Yin, H.; Porter, N. A. *Antioxidants & redox signaling* **2005**, *7*, 170–184.
- (36) Yin, H.; Xu, L.; Porter, N. A. *Chemical reviews* **2011**, *111*, 5944–5972.
- (37) Gardner, H. W. *Free Radical Biology and Medicine* **1989**, *7*, 65–86.
- (38) Mallécol, J.; Lemaire, J.; Gardette, J. L. *Progress in Organic Coatings* **2000**, *39*, 107–113.
- (39) Hubert, J. C.; Venderbosch, R. A. M.; Muizebelt, W. J.; Klaasen, R. P.; Zabel, K. H. *Progress in organic coatings* **1997**, *31*, 331–340.
- (40) Oyman, Z. O.; Ming, W.; Micciche, F.; Oostveen, E.; Van Haveren, J.; van Der Linde, R. *Polymer* **2004**, *45*, 7431–7436.
- (41) Oakley, L.; Casadio, F.; Shull, K.; Broadbelt, L. *Applied Physics A: Materials Science & Processing* **2015**, *121*.
- (42) Hermans, J. J.; Keune, K.; van Loon, A.; Iedema, P. D. *Journal of Analytical Atomic Spectrometry* **2015**, *30*, 1600–1608.
- (43) Hermans, J. J.; Keune, K.; van Loon, A.; Corkery, R. W.; Iedema, P. D. *RSC Advances* **2016**, *6*, 93363–93369.

- (44) Van der Wel, G.; Adan, O. *Progress in Organic Coatings* **1999**, *37*, 1–14.
- (45) Fieldson, G. T.; Barbari, T. A. *Polymer* **1993**, *34*, 1146–1153.
- (46) Hong, S. U.; Barbari, T. A.; Sloan, J. M. *Journal of Polymer Science Part B: Polymer Physics* **1998**, *36*, 337–344.
- (47) Sammon, C.; Yarwood, J.; Everall, N. *Polymer* **2000**, *41*, 2521–2534.
- (48) Guo, J.; Barbari, T. A. *Macromolecules* **2009**, *42*, 5700–5708.
- (49) Farinas, K. C.; Doh, L.; Venkatraman, S.; Potts, R. O. *Macromolecules* **1994**, *27*, 5220–5222.
- (50) Dias, M.; Hadgraft, J.; Raghavan, S.; Tetteh, J. *Journal of Pharmaceutical Sciences* **2004**, *93*, 186–196.
- (51) Van Alsten, J. G. *Macromolecules* **1996**, *29*, 2163–2168.
- (52) Fleming, O. S.; Chan, K. L. A.; Kazarian, S. G. *Polymer* **2006**, *47*, 4649–4658.
- (53) Stolow, N. *Nature* **1957**, *179*, 579–580.
- (54) Phenix, A. *Journal of the American Institute for Conservation* **2002**, *41*, 43.
- (55) Ward, S. A.; Pethrick, R. A. *Progress in Organic Coatings* **2012**, *75*, 509–526.
- (56) Sharma, V.; Banait, J. S.; Kundu, P. P. *Journal of applied polymer science* **2009**, *111*, 1816–1827.
- (57) Chan, T. Y. A.; Odlyha, M. *Thermochimica Acta* **1995**, 269–270, 755–767.
- (58) Nguyen, T.; Bentz, D.; Byrd, E. *JCT, Journal of coatings technology* **1995**, *67*, 37–46.
- (59) Liu, B.; Li, Y.; Lin, H.; Cao, C.-n. *Corrosion Science* **2002**, *44*, 2657–2664.
- (60) Xu, Y.; Yan, C.; Ding, J.; Gao, Y.; Cao, C. *Progress in Organic Coatings* **2002**, *45*, 331–339.
- (61) Van der Zanden, A.; Goossens, E. *Chemical Engineering Science* **2003**, *58*, 1521–1530.
- (62) Saarinen, V.; Kreuer, K. D.; Schuster, M.; Merkle, R.; Maier, J. *Solid State Ionics* **2007**, *178*, 533–537.
- (63) Hallinan, D. T.; De Angelis, M. G.; Giacinti Baschetti, M.; Sarti, G. C.; Elabd, Y. A. *Macromolecules* **2010**, *43*, 4667–4678.
- (64) Hickner, M. A. *Journal of Polymer Science Part B: Polymer Physics* **2012**, *50*, 9–20.
- (65) Dishari, S. K.; Hickner, M. A. *ACS Macro Letters* **2012**, *1*, 291–295.
- (66) Davis, E. M.; Stafford, C. M.; Page, K. A. *ACS Macro Letters* **2014**, *3*, 1029–1035.
- (67) Podgorski, L.; Merlin, A.; Saiter, J. *Journal of Thermal Analysis and Calorimetry* **1994**, *41*, 1319–1324.
- (68) Hedley, G.; Odlyha, M.; Burnstock, A.; Tillinghast, J.; Husband, C. *EN Studies in Conservation* **1990**, *35*, 98–105.
- (69) Phenix, A. *Postprints (American Institute for Conservation of Historic and Artistic Works. Paintings Specialty Group)* **2009**, *22*, 72–89.
- (70) Sanches, D.; Ramos, A. M.; Coelho, J. F. J.; Costa, C. S. M. F.; Vilarigues, M.; Melo, M. J. *Polymer Degradation and Stability* **2017**, *138*, 201–211.
- (71) Ploeger, R.; Scalarone, D.; Chiantore, O. *Polymer Degradation and Stability* **2009**, *94*, 2036–2041.
- (72) Mosiewicki, M. A.; Rojas, O.; Sibaja, M. R.; Borrajo, J.; Aranguren, M. I. *Polymer international* **2007**, *56*, 875–881.
- (73) Boquillon, N.; Fringant, C. *Polymer* **2000**, *41*, 8603–8613.
- (74) Earnest, T. R.; MacKnight, W. J. *Macromolecules* **1980**, *13*, 844–849.

- (75) Eisenberg, A *Macromolecules* **1970**, *3*, 147–154.
- (76) Eisenberg, A.; Hird, B.; Moore, R. B. *Macromolecules* **1990**, *23*, 4098–4107.
- (77) Hermans, J. J.; Keune, K.; van Loon, A.; Iedema, P. D. *Physical Chemistry Chemical Physics* **2016**, *18*, 10896–10905.
- (78) Park, J.; Eslick, J.; Ye, Q.; Misra, A.; Spencer, P. *Dental Materials* **2011**, *27*, 1086–1093.
- (79) Hill, L. W. *Progress in Organic Coatings* **1997**, *31*, 235–243.
- (80) Weiss, R. A.; Fitzgerald, J. J.; Kim, D *Macromolecules* **1991**, *24*, 1064–1070.
- (81) Giacinti Baschetti, M.; Piccinini, E.; Barbari, T. A.; Sarti, G. C. *Macromolecules* **2003**, *36*, 9574–9584.
- (82) Browne, F. L. *Forest Products Journal* **1956**, 312–318.
- (83) Zumbuhl, S.; Scherrer, N. C.; Engel, N. L.; Muller, W. In *ICOM-CC, 17th Triennial Conference*, 2014, pp 1–11.
- (84) Phenix, A. *Smithsonian Contributions to Museum Conservation* **2013**, *3*, 69–76.
- (85) Brannon-Peppas, L.; Peppas, N. A. *Chemical Engineering Science* **1991**, *46*, 715–722.
- (86) Edwards, D. A. *Journal of Polymer Science: Part B: Polymer Physics* **1996**, *34*, 981–997.
- (87) Amsden, B. *Macromolecules* **1998**, *31*, 8382–8395.
- (88) Masaro, L.; Zhu, X. X., *Physical models of diffusion for polymer solutions, gels and solids*; 5; Elsevier: 1999; Vol. 24, pp 731–775.
- (89) De Kee, D; Liu, Q; Hinestroza, J *The Canadian Journal of Chemical Engineering* **2005**, *83*, 913–929.
- (90) Vrentas, J. S.; Duda, J. L. *Journal of Polymer Science: Polymer Physics Edition* **1977**, *15*, 403–416.
- (91) Vrentas, J. S.; Duda, J. L. *Journal of Polymer Science: Polymer Physics Edition* **1977**, *15*, 417–439.
- (92) Bisschops, M. A.; Luyben, K. C. A.; Van Der Wielen, L. A. *Industrial and Engineering Chemistry Research* **1998**, *37*, 3312–3322.
- (93) Stolow, N. *Journal of the Oil and Colour Chemists' Association* **1957**, *40*, 377–402.
- (94) Guo, J.; Barbari, T. A. *Macromolecules* **2008**, *41*, 238–245.
- (95) Duncan, T. T.; Berrie, B. H.; Weiss, R. G. *ACS Applied Materials & Interfaces* **2017**, *9*, 28069–28078.
- (96) Baglioni, M.; Domingues, J. A. L.; Carretti, E.; Fratini, E.; Chelazzi, D.; Giorgi, R.; Baglioni, P. *ACS Applied Materials & Interfaces* **2018**, *10*, 19162–19172.
- (97) Yao, K. Z.; Shaw, B. M.; Kou, B.; McAuley, K. B.; Bacon, D. W. *Polymer Reaction Engineering* **2003**, *11*, 563–588.
- (98) *Handbook of Chemistry and Physics*, 64th; Weast, R. C., Ed.; CRC Press: 1983, F170.
- (99) Foster, G. M.; Ritchie, S; Lowe, C *Journal of Thermal Analysis and Calorimetry* **2003**, *73*, 119–126.
- (100) Ormsby, B.; Foster, G.; Learner, T.; Ritchie, S.; Schilling, M. *Journal of Thermal Analysis and Calorimetry* **2007**, *90*, 503–508.
- (101) Monico, L.; Janssens, K.; Miliani, C.; Van Der Snickt, G.; Brunetti, B. G.; Cestelli Guidi, M.; Radepon, M.; Cotte, M.; Vagnini, M.; Vanmeert, F.; Falkenberg, G.; Abakumov, A.; Lu, Y.; Tian, H.; Verbeeck, J.; Radepon, M.; Cotte, M.; Hendriks, E.; Geldof, M.; Van Der Loeff, L.; Salvant, J.; Menu, M. *Analytical Chemistry* **2013**, *85*, 860–867.
- (102) Gabrieli, F.; Rosi, F.; Vichi, A.; Cartechini, L.; Pensabene Buemi, L.; Kazarian, S. G.; Miliani, C. *Analytical Chemistry* **2017**, *89*, 1283–1289.

- (103) Van Alsten, J. G.; Lustig, S. R. *Macromolecules* **1992**, *25*, 5069–5073.
- (104) Hermans, J. J.; Keune, K.; Van Loon, A.; Corkery, R. W.; Iedema, P. D. *Polyhedron* **2014**, *81*, 335–340.
- (105) Saito, M.; Arimura, N.; Hayamizu, K.; Okada, T. *The Journal of Physical Chemistry B* **2004**, *108*, 16064–16070.
- (106) Spring, M.; Ricci, C.; Peggie, D. A.; Kazarian, S. G. *Analytical and Bioanalytical Chemistry* **2008**, *392*, 37–45.
- (107) Hageraats, S.; Keune, K.; Refregiers, M.; van Loon, A.; Berrie, B. H.; Thoury, M. *Analytical Chemistry* **2019**, acs.analchem.9b02443.
- (108) Keles, H.; Naylor, A.; Clegg, F.; Sammon, C. *The Analyst* **2014**, *139*, 2355–2369.
- (109) Hermans, J. J.; Baij, L.; Koenis, M.; Keune, K.; Iedema, P. D.; Woutersen, S. *Science Advances* **2019**, *5*, eaaw3592.
- (110) Brozoski, B. A.; Painter, P. C.; Coleman, M. M. *Macromolecules* **1984**, *17*, 1591–1594.
- (111) Jones, P. L. *Studies in Conservation* **1965**, *10*, 119.
- (112) Van den Berg, J. D.; van den Berg, K. J.; Boon, J. J. *Journal of Chromatography A* **2002**, *950*, 195–211.
- (113) Sutherland, K. *Studies in conservation* **2003**, *48*, 111–135.
- (114) Spyros, A.; Anglos, D. *Analytical Chemistry* **2004**, *76*, 4929–4936.
- (115) Bonaduce, I.; Carlyle, L.; Colombini, M. P.; Duce, C.; Ferrari, C.; Ribechini, E.; Selleri, P.; Tiné, M. R. *PLoS ONE* **2012**, *7*, ed. by Wanunu, M., e49333.
- (116) La Nasa, J.; Modugno, F.; Aloisi, M.; Lluveras-Tenorio, A.; Bonaduce, I. *Analytica Chimica Acta* **2018**, *1001*, 51–58.
- (117) Modugno, F.; Gianvincenzo, F. D.; Degano, I.; Dorothé Van Der Werf, I.; Bonaduce, I.; Klaas, & Van Den Berg, J.; Di Gianvincenzo, F.; Degano, I.; van der Werf, I. D.; Bonaduce, I.; van den Berg, K. J. *Scientific Reports* **2019**, *9*, 5533.
- (118) Jiang, X.; Li, S.; Xiang, G.; Li, Q.; Fan, L.; He, L.; Gu, K. *Food Chemistry* **2016**, *212*, 585–589.
- (119) Mahesar, S. A.; Sherazi, S. T. H.; Khaskheli, A. R.; Kandhro, A. A.; Uddin, S. *Anal. Methods* **2014**, *6*, 4956–4963.
- (120) Schilling, M. R.; Heginbotham, A.; van Keulen, H.; Szelewski, M. *Studies in Conservation* **2016**, *61*, 3–27.
- (121) Suzuki, H.; Wang, B.; Yoshida, R.; Kokufuta, E. *Langmuir* **1999**, *15*, 4283–4288.
- (122) Baij, L.; Hermans, J. J.; Keune, K.; Iedema, P. D. *Macromolecules* **2018**, *51*, 7134–7144.
- (123) Malledol, J.; Gardette, J.-L.; Lemaire, J. *Journal of the American Oil Chemists' Society* **1999**, *76*, 967–976.
- (124) Marshall, G.; Cudby, M.; Smith, K.; Stevenson, T.; Packer, K.; Harris, R. *Polymer* **1987**, *28*, 1093–1097.
- (125) De Viguerie, L.; Payard, P.; Portero, E.; Walter, P.; Cotte, M. *Progress in Organic Coatings* **2016**, *93*, 46–60.
- (126) *Artists Pigments, Volume 1*; Feller, R., Ed.; Cambridge University Press: Cambridge, 1986, p 61.
- (127) Van Driel, B.; Kooyman, P.; van den Berg, K.; Schmidt-Ott, A.; Dik, J. *Microchemical Journal* **2016**, *126*, 162–171.

- (128) Yano, J.; Sato, K. *Food Research International* **1999**, *32*, 249–259.
- (129) Da Silva, E.; Bresson, S.; Rousseau, D. *Chemistry and Physics of Lipids* **2009**, *157*, 113–119.
- (130) Gopala Krishna, A. G.; Prabhakar, J. V. *Journal of the American Oil Chemists' Society* **1992**, *69*, 178–183.
- (131) Choe, E.; Oh, S. *Journal of Food Science* **2013**, *78*, C1144–C1151.
- (132) Miyashita, K.; Takagi, T. *Journal of the American Oil Chemists' Society* **1986**, *63*, 1380–1384.
- (133) Walborsky, H. M.; Colombini, C. *The Journal of Organic Chemistry* **1962**, *27*, 2387–2390.
- (134) Tsujimoto, T.; Uyama, H.; Kobayashi, S. *Macromolecules* **2004**, *37*, 1777–1782.
- (135) *Issues in Contemporary Oil Paint*; van den Berg, K. J., Burnstock, A., de Keijzer, M., Krueger, J., Learner, T., Tagle de, A., Heydenreich, G., Eds.; Springer International Publishing: Cham, 2014.
- (136) Wouters, M. E. L.; Litvinov, V. M.; Binsbergen, F. L.; Goossens, J. G. P.; van Duin, M.; Dikland, H. G. *Macromolecules* **2003**, *36*, 1147–1156.
- (137) Ishioka, T.; Maeda, K.; Watanabe, I.; Kawachi, S.; Harada, M. *Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy* **2000**, *56*, 1731–1737.
- (138) Welty, A.; Ooi, S.; Grady, B. P. *Macromolecules* **1999**, *32*, 2989–2995.
- (139) Hashimoto, H.; Kutsumizu, S.; Tsunashima, K.; Yano, S. *Macromolecules* **2001**, *34*, 1515–1517.
- (140) Ikeda, Y.; Yasuda, Y.; Ohashi, T.; Yokohama, H.; Minoda, S.; Kobayashi, H.; Honma, T. *Macromolecules* **2015**, *48*, 462–475.
- (141) Osmond, G.; Boon, J. J.; Puskar, L.; Drennan, J. *Applied Spectroscopy* **2012**, *66*, 1136–1144.
- (142) Andor, J. A.; Berkesi, O.; Dreveni, I.; Varga, E. *Lubrication Science* **1999**, *11*, 115–134.
- (143) Dreveni, I.; Berkesi, O.; Andor, J.; Mink, J. *Inorganica Chimica Acta* **1996**, *249*, 17–23.
- (144) Berkesi, O.; Berenji, P.; Dreveni, I.; Körtvélyesi, T.; Andor, J.; Mink, J.; Goggin, P. *Vibrational Spectroscopy* **2007**, *43*, 227–236.
- (145) Clegg, W.; Harbron, D. R.; Homan, C. D.; Hunt, P. A.; Little, I. R.; Straughan, B. P. *Inorganica Chimica Acta* **1991**, *186*, 51–60.
- (146) Berkesi, O.; Dreveni, I.; Andor, J.; Goggin, P. *Inorganica Chimica Acta* **1991**, *181*, 285–289.
- (147) Berkesi, O.; Andor, J. A.; Jayasooriya, U. A.; Cannon, R. D. *Spectrochimica Acta Part A: Molecular Spectroscopy* **1992**, *48*, 147–149.
- (148) Baij, L.; Astefanei, A.; Hermans, J.; Brinkhuis, F.; Groenewegen, H.; Chassouant, L.; Johansson, S.; Corthals, G.; Tokarski, C.; Iedema, P.; Keune, K. *Heritage Science* **2019**, *7*, 31.
- (149) Tudryn, G. J.; O'Reilly, M. V.; Dou, S.; King, D. R.; Winey, K. I.; Runt, J.; Colby, R. H. *Macromolecules* **2012**, *45*, 3962–3973.
- (150) Iwasaki, T.; Maegawa, Y.; Hayashi, Y.; Ohshima, T.; Mashima, K. *The Journal of Organic Chemistry* **2008**, *73*, 5147–5150.
- (151) Yarusso, D. J.; Cooper, S. L. *Macromolecules* **1983**, *16*, 1871–1880.
- (152) Ishioka, T.; Kobayashi, M. *Macromolecules* **1990**, *23*, 3183–3186.
- (153) Tsujita, Y.; Yasuda, M.; Kinoshita, T.; Takizawa, A.; Yoshimizu, H.; Davies, G. R. *Journal of Polymer Science, Part B: Polymer Physics* **2002**, *40*, 831–839.
- (154) Gebel, G.; Lambard, J. *Macromolecules* **1997**, *30*, 7914–7920.

- (155) Jackson, D. A.; Koberstein, J. T.; Weiss, R. A. *Journal of Polymer Science Part B: Polymer Physics* **1999**, *37*, 3141–3150.
- (156) Tian, Q.; Yan, G.; Bai, L.; Li, X.; Zou, L.; Rosta, L.; Wacha, A.; Li, Q.; Krakovský, I.; Yan, M.; Almásy, L. *Polymer* **2018**, *147*, 1–7.
- (157) Kutsumizu, S.; Tagawa, H.; Muroga, Y.; Yano, S. *Macromolecules* **2000**, *33*, 3818–3827.
- (158) Morioka, H.; Tagaya, H.; Karasu, M.; Kadokawa, J.-i.; Chiba, K. *Journal of Materials Research* **1998**, *13*, 848–851.
- (159) Rehr, J. J.; Kas, J. J.; Vila, F. D.; Prange, M. P.; Jorissen, K. *Physical Chemistry Chemical Physics* **2010**, *12*, 5503.
- (160) Borsboom, M.; Bras, W.; Cerjak, I.; Detollenaere, D.; Glastra van Loon, D.; Goettkindt, P.; Konijnenburg, M.; Lassing, P.; Levine, Y. K.; Munneke, B.; Oversluizen, M.; van Tol, R.; Vlieg, E. *Journal of Synchrotron Radiation* **1998**, *5*, 518–520.
- (161) Michalski, S. *Studies in Conservation* **1990**, *35*, 85–92.
- (162) Phenix, A.; Graczyk, A. *AIC Paintings Specialty Group Postprints* **2015**, *28*, 89–97.
- (163) Vergeer, M.; van den Berg, K. J.; van Oudheusden, S.; Stols-Witlox, M., *Evolon® CR microfibre cloth as a tool for varnish removal*, 2019, pp 587–596.
- (164) Domingues, J. A. L.; Bonelli, N.; Giorgi, R.; Fratini, E.; Gorel, F.; Baglioni, P. *Langmuir* **2013**, *29*, 2746–2755.
- (165) Astefanei, A.; van Bommel, M.; Corthals, G. L. *Journal of The American Society for Mass Spectrometry* **2017**, *28*, 2108–2116.
- (166) Keune, K.; Boon, J. J. *Analytical Chemistry* **2004**, *76*, 1374–1385.
- (167) Joseph, E.; Ricci, C.; Kazarian, S. G.; Mazzeo, R.; Prati, S.; Ioele, M. *Vibrational Spectroscopy* **2010**, *53*, 274–278.
- (168) Ruhemann, H.; Plesters, J., *The cleaning of paintings; problems and potentialities*; Faber: London, 1968, p 508.
- (169) Baij, L.; Hermans, J.; Ormsby, B.; Noble, P.; Iedema, P.; Keune, K. *Heritage Science* **2020**, *8*, 43.
- (170) Fife, G. R.; Stabik, B.; Kelley, A. E.; King, J. N.; Blümich, B.; Hoppenbrouwers, R.; Meldrum, T. *Magnetic Resonance in Chemistry* **2015**, *53*, 58–63.
- (171) Erhardt, D.; Tsang, J.-S. *Studies in Conservation* **1990**, *35*, 93–97.
- (172) Spyros, A.; Anglos, D. *Applied Physics A: Materials Science and Processing* **2006**, *83*, 705–708.
- (173) Casoli, A.; Di Diego, Z.; Isca, C. *Environmental Science and Pollution Research* **2014**, *21*, 13252–13263.
- (174) Kahrim, K.; Daveri, A.; Rocchi, P.; de Cesare, G.; Cartechini, L.; Miliari, C.; Brunetti, B.; Sgamellotti, A. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* **2009**, *74*, 1182–1188.
- (175) Baglioni, P.; Baglioni, M.; Bonelli, N.; Chelazzi, D.; Giorgi, R. In *Nanotechnologies and Nanomaterials for Diagnostic, Conservation and Restoration of Cultural Heritage*; Elsevier: Dordrecht, 2019, pp 171–204.
- (176) *Gels in the conservation of art*; Angelova, L. V., Ormsby, B., Townsend, J., Wolbers, R., Eds.; Archetype Publications: London, 2018, p 400.
- (177) Michalski, S. *Art in Transit: Studies in the Transport of Paintings* **1991**, 223–248.

- (178) Monico, L.; Van der Snickt, G.; Janssens, K.; De Nolf, W.; Miliani, C.; Verbeeck, J.; Tian, H.; Tan, H.; Dik, J.; Radepont, M.; Cotte, M. *Analytical Chemistry* **2011**, *83*, 1214–1223.
- (179) Phenix, A. *Journal of the American Institute for Conservation* **2002**, *41*, 61.
- (180) Masschelein-Kleiner, L, *Les solvants; Cours de conservation; Institut royal du patrimoine artistique: Bruxelles, 1994.*
- (181) Prati, S.; Sciutto, G.; Volpi, F.; Rehorn, C.; Vurro, R.; Blümich, B.; Mazzocchetti, L.; Giorgini, L.; Samorì, C.; Galletti, P.; Tagliavini, E.; Mazzeo, R. *New Journal of Chemistry* **2019**, *43*, 8229–8238.
- (182) Blümich, B.; Blümler, P.; Eidmann, G.; Guthausen, A.; Haken, R.; Schmitz, U.; Saito, K.; Zimmer, G. *Magnetic Resonance Imaging* **1998**, *16*, 479–484.
- (183) Angelova, L. V.; Ormsby, B.; Richardson, E. *Microchemical Journal* **2016**, *124*, 311–320.
- (184) Fercher, A.; Briers, J. *Optics Communications* **1981**, *37*, 326–330.
- (185) Van der Kooij, H. M.; Sprakel, J. *Soft Matter* **2015**, *11*, 6353–6359.
- (186) Van der Kooij, H. M.; Fokkink, R.; van der Gucht, J.; Sprakel, J. *Scientific Reports* **2016**, *6*, 34383.
- (187) Pérez, A.; González-Peña, R.; Braga Jr, R.; Perles, Á.; Pérez-Marín, E.; García-Diego, F. *Sensors* **2018**, *18*, 190.
- (188) Buijs, J.; van der Gucht, J.; Sprakel, J. *Scientific Reports* **2019**, *9*, 13279.
- (189) Kühn, H. In *Artist's pigments: A handbook of their history and characteristics, vol. 1*, Feller, R., Ed.; Cambridge University Press and National Gallery of Art: Cambridge and London, 1986, pp 169–186.
- (190) Ankersmit, B.; Stappers, M. H., *Managing Indoor Climate Risks in Museums; Cultural Heritage Science; Springer International Publishing: Cham, 2017.*
- (191) Zumbühl, S. *Studies in Conservation* **2014**, *59*, 24–37.
- (192) Arecchi, T; Bellini, M; Corsi, C; Fontana, R; Materazzi, M; Pezzati, L; Tortora, A *Optics and Spectroscopy* **2006**, *101*, 23–26.
- (193) Prati, S.; Volpi, F.; Fontana, R.; Galletti, P.; Giorgini, L.; Mazzeo, R.; Mazzocchetti, L.; Samorì, C.; Sciutto, G.; Tagliavini, E. *Pure and Applied Chemistry* **2018**, *90*, 239–251.
- (194) Fife, G.; Och, J. V.; Stabik, B.; Miedema, N.; Seymour, K. *ICOM-CC 16th triennial conference Lisbon 19-23 September 2011: preprints* **2011**.
- (195) Gilson, E; Gilson Etienne, *Painting and Reality; A.W. Mellon lectures in the fine arts; Pantheon Books: New York, 1959, p 484.*
- (196) Monico, L.; Van der Snickt, G.; Janssens, K.; De Nolf, W.; Miliani, C.; Dik, J.; Radepont, M.; Hendriks, E.; Geldof, M.; Cotte, M. *Analytical Chemistry* **2011**, *83*, 1224–1231.
- (197) Monico, L.; Janssens, K.; Miliani, C.; Brunetti, B. G.; Vagnini, M.; Vanmeert, F.; Falkenberg, G.; Abakumov, A.; Lu, Y.; Tian, H.; Verbeeck, J.; Radepont, M.; Cotte, M.; Hendriks, E.; Geldof, M.; Van Der Loeff, L.; Salvant, J.; Menu, M. *Analytical Chemistry* **2013**, *85*, 851–859.
- (198) Genty-Vincent, A.; Eveno, M.; Nowik, W.; Bastian, G.; Ravaud, E.; Cabillic, I.; Uziel, J.; Lubin-Germain, N.; Menu, M. *Applied Physics A* **2015**, *121*, 779–788.
- (199) Erhardt, D.; Tumosa, C. S.; Mecklenburg, M. F. *Polymer Preprints* **2000**, *41*, 1790–1791.
- (200) Tan, H.; Tian, H.; Verbeeck, J.; Monico, L.; Janssens, K.; Van Tendeloo, G. *Angewandte Chemie - International Edition* **2013**, *52*, 11360–11363.

- (201) Tant, M. R.; Mauritz, K. A.; Wilkes, G. L., *Ionomers: Synthesis, structure, properties and applications*; Springer Netherlands: Dordrecht, 1997, p 528.
- (202) Kerres, J. A. *Fuel Cells* **2005**, *5*, 230–247.
- (203) Shahinpoor, M; Bar-Cohen, Y; Simpson, J. O.; Smith, J *Smart Materials and Structures* **1998**, *7*, R15–R30.
- (204) Hatipoglu, G.; Liu, Y.; Zhao, R.; Yoonessi, M.; Tigelaar, D. M.; Tadigadapa, S.; Zhang, Q. M. *Smart Materials and Structures* **2012**, *21*, 055015.
- (205) Li, J.; Park, J. K.; Moore, R. B.; Madsen, L. A. *Nature Materials* **2011**, *10*, 507–511.
- (206) Oh, K. T.; Bronich, T. K.; Bromberg, L.; Hatton, T. A.; Kabanov, A. V. *Journal of Controlled Release* **2006**, *115*, 9–17.
- (207) Hallinan Jr, D. T.; Elabd, Y. A.; Hallinan, D. T.; Elabd, Y. A. *The Journal of Physical Chemistry B* **2007**, *111*, 13221–13230.
- (208) Modesti, G.; Zimmermann, B.; Borsch, M.; Herrmann, A.; Saalwachter, K. *Macromolecules* **2009**, *42*, 4681–4689.
- (209) Philippe, L.; Sammon, C.; Lyon, S. B.; Yarwood, J. *Progress in Organic Coatings* **2004**, *49*, 302–314.
- (210) Wakabayashi, K.; Register, R. A. *Polymer* **2006**, *47*, 2874–2883.
- (211) Ikeda, Y.; Yasuda, Y.; Ohashi, T.; Yokohama, H.; Minoda, S.; Kobayashi, H.; Honma, T. *Macromolecules* **2015**, *48*, 462–475.
- (212) Barberio, M.; Skantzakis, E.; Sorieul, S.; Antici, P. *Science Advances* **2019**, *5*, eaar6228.
- (213) Seniha Güner, F.; Yagcı, Y.; Tuncer Erciyes, A. *Progress in Polymer Science* **2006**, *31*, 633–670.
- (214) Hofland, A. *Progress in Organic Coatings* **2012**, *73*, 274–282.
- (215) Perera, D. Y. *Progress in Organic Coatings* **2004**, *50*, 247–262.
- (216) Erich, S. J. F.; Huinink, H. P.; Adan, O. C. G.; Laven, J.; Esteves, A. C. *Progress in Organic Coatings* **2008**, *63*, 399–404.
- (217) Burnstock, A.; van den Berg, K. J.; de Groot, S.; Wijnberg, L. *Modern Paints Uncovered* **2007**, 177–188.
- (218) Blumenroth, D.; Zumbühl, S.; Scherrer, N. C.; Müller, W. In *Issues in Contemporary Oil Paint*; Springer International Publishing: Cham, 2014, pp 351–362.
- (219) Fuesers, O.; Zumbühl, S. *9th International Conference on NDT of Art, Jerusalem, Israel, 25-30 May 2008* **2008**, 1–14.
- (220) Dossie, R., *The handmaid to the arts*, London, 1764.
- (221) Manfred Koller Surface Cleaning and Conservation.
- (222) Church, A. H., *The Chemistry of Paints and Paintings*, 4th ed.; Seeley, Service & Co. Limited: London, 1915.
- (223) De Wild, A. Het natuurwetenschappelijk onderzoek van schilderijen., Ph.D. Thesis, Technische Universiteit Delft, 1928.
- (224) Stolow, N *Journal of Scientific Instruments* **1954**, *31*, 416–420.
- (225) Modestini, D. D. *Metropolitan Museum Journal* **2005**, *40*, 27–36.
- (226) Brouwer, T.; Schuur, B. *Industrial & Engineering Chemistry Research* **2019**, acs.iecr.9b00727.

- (227) *Nanoscience for the Conservation of Works of Art*; Baglioni, P., Chelazzi, D., Eds.; Nanoscience & Nanotechnology Series; Royal Society of Chemistry: Cambridge, 2013.
- (228) Hildebrand, J. H.; Scott, R. L., *The solubility of nonelectrolytes*, 3rd ed.; American Chemical Society monograph series; Dover Publications, Inc.: New York, 1964.
- (229) Teas, J. P. *Journal of paint technology* **1968**, *40*, 19–25.
- (230) Fink, J. K. In *Reactive Polymers Fundamentals and Applications*; Elsevier: Leoben, 2013, pp 303–315.
- (231) Hansen, C. M. The three dimensional solubility parameter., Ph.D. Thesis, 1967.
- (232) Hansen, C. M., *Hansen Solubility Parameters*; CRC Press: London, 2007.
- (233) Barton, A. F. M., *CRC Handbook of Solubility Parameters and Other Cohesion Parameters*, 2nd ed.; Routledge: New York, 1991.
- (234) Kanegsberg, B.; Kanegsberg, E., *Handbook for Critical Cleaning*; CRC Press: Abingdon, 2011.
- (235) Hedley, G. *The Conservator* **1980**, *4*, 12–18.
- (236) Chelazzi, D.; Giorgi, R.; Baglioni, P. *Angewandte Chemie International Edition* **2018**, *57*, 7296–7303.
- (237) Phenix, A.; Mar Parkin, H. In *2002 AIC Paintings Specialty Group Postprints, Miami, Florida, June 6-11, 2002*, 2002, pp 71–86.
- (238) Stavroudis, C.; Blank, S. *WAAC newsletter* **1989**, *11*, 2–10.
- (239) Phenix, A. *Zeitschrift für Kunsttechnologie und Konservierung* **1998**, *12*, 387–409.
- (240) Zumbühl, S. *Zeitschrift für Kunsttechnologie und Konservierung: ZKK* **2005**, *19*, 253–263.
- (241) Saera Vila, A.; Barros Garcia, J. M. In *New Insights into the Cleaning of Paintings: Proceedings from the Cleaning 2010 International Conference Universidad Politecnica de Valencia and Museum Conservation Institute*, 2013, pp 35–38.
- (242) Macchia, A.; Rivaroli, L.; Gianfreda, B. *Natural Product Research* **2019**, 1–11.
- (243) Zumbühl, S., *Solvents, Solvation, Solubilization, Solution: The solubility of materials - An introduction for conservators, including solubility data of selected conservation materials*; HDW Publications: Bern, 2019.
- (244) Stavroudis, C.; Doherty, T. *Newsletter (Western Association for Art Conservation)* **2007**, *29*, 9–15.
- (245) Fardi, T.; Stefanis, E.; Panayiotou, C.; Abbott, S.; van Loon, S. *Journal of Cultural Heritage* **2014**, *15*, 583–594.
- (246) Horta, A.; Pastoriza, M. A. The interaction parameter of crosslinked networks and star polymers., 2005.
- (247) Quesada-Pérez, M.; Maroto-Centeno, J. A.; Forcada, J.; Hidalgo-Alvarez, R. Gel swelling theories: The classical formalism and recent approaches., 2011.
- (248) Lopez, C. G.; Richtering, W. *Soft Matter* **2017**, *13*, 8271–8280.
- (249) Browne, F. *Forest Products Journal* **1953**, 108–125.
- (250) Browne, F. *Forest Products Journal* **1955**, 92–96.
- (251) Browne, F. *Forest Products Journal* **1955**, 142–146.
- (252) Browne, F. *Forest Products Journal* **1955**, 192–200.
- (253) Browne, F. *Forest Products Journal* **1956**, 152–159.
- (254) Browne, F. *Forest Products Journal* **1956**, 235–240.

- (255) Browne, F. L. *Forest Products Journal* **1956**, 453–458.
- (256) Browne, F. *Forest Products Journal* **1957**, 145–154.
- (257) Browne, F. *Forest Products Journal* **1957**, 7, 248–252.
- (258) Burnstock, A.; Learner, T. *Studies in Conservation* **1992**, 37, 165.
- (259) McGlinchey, C. W. *MRS Proceedings* **1990**, 185, 93.
- (260) Mecklenburg, M. F.; Tumosa, C. S.; Erhardt, D. *MRS Proceedings* **2004**, 852, ed. by Vandiver, P. B.; Mass, J. L.; Murray, A., OO3.1.
- (261) Erhardt, D.; Tumosa, C. S.; Mecklenburg, M. F. *Studies in Conservation* **2005**, 50, 143–150.
- (262) Ordonez, E.; Twilley, J. *Analytical Chemistry* **1997**, 69, 416A–422A.
- (263) Feller, R. L.; Stolow, N.; Jones, E. H., *On picture varnishes and their solvents*; The Press of Case Western Reserve University: Cleveland and London, 1985.
- (264) Van Den Berg, J. D. J.; Van Den Berg, K. J.; Boon, J. J. *Progress in Organic Coatings* **2001**, 41, 143–155.
- (265) Sutherland, K. *Journal of Chromatography A* **2007**, 1149, 30–37.
- (266) Van Dam, E. P.; van den Berg, K. J.; Proaño Gaibor, A. N.; van Bommel, M. *International Journal of Mass Spectrometry* **2017**, 413, 33–42.
- (267) Baij, L.; Buijs, J.; Hermans, J. J.; Raven, L.; Iedema, P. D.; Keune, K.; Sprakel, J. *Scientific Reports* **2020**, Accepted.
- (268) Tauber, G.; Smelt, S.; Noble, P.; Kirsch, K.; Siejek, A.; Keune, K.; van Keulen, H.; Smulders-De Jong, S.; Erdman, R. *AIC Paintings Specialty Group Postprints* **2018**, 31, 45–50.
- (269) Stulik, D.; Miller, D.; Khanjian, H.; Khandekar, N.; Wolbers, R.; Carlson, J.; Peterson, W. C., *Solvent Gels for the Cleaning of Works of Art: The Residue Question*; The Getty Conservation Institute: Los Angeles, 2004.
- (270) Samori, C.; Galletti, P.; Giorgini, L.; Mazzeo, R.; Mazzocchetti, L.; Prati, S.; Sciutto, G.; Volpi, F.; Tagliavini, E. *ChemistrySelect* **2016**, 1, 4502–4508.
- (271) Volpi, F. Green Strategies for the Cleaning of Works of Art Setting Up of an Analytical Protocol for the Evaluation of Cleaning., Ph.D. Thesis, alma, 2017.
- (272) Bartoletti, A.; Barker, R.; Chelazzi, D.; Bonelli, N.; Baglioni, P.; Lee, J.; Angelova, L. V.; Ormsby, B. *Heritage Science* **2020**, 8, 9.
- (273) Baglioni, P.; Chelazzi, D.; Giorgi, R., *Nanotechnologies in the Conservation of Cultural Heritage: A Compendium of Materials and Techniques*; Springer Netherlands: Dordrecht, 2014, p 144.
- (274) Baglioni, P.; Carretti, E.; Chelazzi, D. *Nature Nanotechnology* **2015**, 10, 287–290.
- (275) Domingues, J.; Bonelli, N.; Giorgi, R.; Fratini, E.; Baglioni, P. *International journal of conservation science* **2013**, 4, 715–722.
- (276) Angelova, L. V.; Terech, P.; Natali, I.; Dei, L.; Carretti, E.; Weiss, R. G. *Langmuir* **2011**, 27, 11671–11682.
- (277) Angelova, L. V.; Berrie, B. H.; de Ghetaldi, K.; Kerr, A.; Weiss, R. G. *Studies in Conservation* **2015**, 60, 227–244.
- (278) Duncan, T. T.; Weiss, R. G. *Colloid and Polymer Science* **2018**, 296, 1047–1056.
- (279) Morris, E. R.; Nishinari, K.; Rinaudo, M. *Food Hydrocolloids* **2012**, 28, 373–411.
- (280) Lahaye, M.; Rochas, C. *Hydrobiologia* **1991**, 221, 137–148.

- (281) Davies, E.; Huang, Y.; Harper, J. B.; Hook, J. M.; Thomas, D. S.; Burgar, I. M.; Lillford, P. J. *International Journal of Food Science & Technology* **2010**, *45*, 2502–2507.
- (282) Scott, C. L. *Objects Specialty Group Postprints* **2012**, *19*, 71–83.
- (283) Ormsby, B.; Keefe, M.; Phenix, A.; von Aderkas, E.; Learner, T.; Tucker, C.; Kozak, C. *Journal of the American Institute for Conservation* **2016**, *55*, 12–31.
- (284) Cremonesi, P. *Studies in Conservation* **2016**, *61*, 362–367.
- (285) Wolbers, R. C. *EN Studies in Conservation* **1990**, *35*, 119–125.
- (286) Pizzorusso, G.; Fratini, E.; Eiblmeier, J.; Giorgi, R.; Chelazzi, D.; Chevalier, A.; Baglioni, P. *Langmuir* **2012**, *28*, 3952–3961.
- (287) Domingues, J.; Bonelli, N.; Giorgi, R.; Baglioni, P. *Applied Physics A* **2014**, *114*, 705–710.
- (288) Noferini, D.; Faraone, A.; Rossi, M.; Mamontov, E.; Fratini, E.; Baglioni, P. *The Journal of Physical Chemistry C* **2019**, *123*, 19183–19194.
- (289) Moretti, P.; Cartechini, L.; Miliani, C. *Analytical and Bioanalytical Chemistry* **2019**, *412*, 1063–1075.