

REFERENCES

- Adnane, L., Kesri, R., & Hamar-Thibault, S. (1992). Vanadium carbides formed from the melt by solidification in Fe-V-X-C alloys (X= Cr, Mo, Nb). *Journal of Alloys and Compounds*, 178(1), 71-84. [https://doi.org/10.1016/0925-8388\(92\)90248-8](https://doi.org/10.1016/0925-8388(92)90248-8)
- Albertin, E., & Sinatora, A. (2001). Effect of carbide fraction and matrix microstructure on the wear of cast iron balls tested in a laboratory ball mill. *Wear*, 250(1), 492-501. [https://doi.org/10.1016/S0043-1648\(01\)00664-0](https://doi.org/10.1016/S0043-1648(01)00664-0)
- ASTM G40. (2018). *Standard terminology relating to wear and erosion*. ASTM International.
- Aungsupaitoon, P. (2008). *Abrasion wear behavior of hypoeutectic 16 mass% chromium cast iron containing molybdenum [Master's thesis, Chulalongkorn University]*.
- Bedolla-Jacuinde, A. (2001). Microstructure of vanadium-, niobium- and titanium-alloyed high-chromium white cast irons. *International Journal of Cast Metals Research*, 13(6), 343-361. <https://doi.org/10.1080/13640461.2001.11819416>
- Bedolla-Jacuinde, A. (2016). Niobium in Cast Irons. In G. Vadim (Ed.), *Progress in Metallic Alloys*. IntechOpen. <https://doi.org/10.5772/64498>
- Bedolla-Jacuinde, A., Guerra, F. V., Mejía, I., & Vera, U. (2019). Niobium Additions to a 15%Cr–3%C White Iron and Its Effects on the Microstructure and on Abrasive Wear Behavior. *Metals*, 9(12), 1321. <https://www.mdpi.com/2075-4701/9/12/1321>
- Bedolla-Jacuinde, A., Guerra, F. V., Mejía, I., Zuno-Silva, J., & Rainforth, M. (2015). Abrasive wear of V–Nb–Ti alloyed high-chromium white irons. *Wear*, 332-333, 1006-1011. <https://doi.org/10.1016/j.wear.2015.01.049>

- Boccalini Jr., M. (2011). Overview: High speed steels for hot rolling mill rolls, *Abrasion Wear Resistant Alloyed White Cast Iron for Rolling and Pulverizing Mills*.
- Boccalini Jr., M., Corrêa, A. V. O., & Sinatora, A. (2008). Niobium in multi-component white cast iron. *Proceedings of the International Conference on Abrasion Wear Resistant Alloyed Cast Iron for Rolling and Pulverizing Mills*.
- Booser, E. R. (1997). *Tribology Data Handbook: An Excellent Friction, Lubrication, and Wear Resource* (1st ed.). <https://doi.org/10.1201/9780367802509>
- Bouhamla, K., Maouche, H., & Hadji, A. (2008). Effect of molybdenum and niobium on the wear behaviour of high chromium white cast iron. *Al-Azhar Engineering International Conference (AEIC), Cairo, Egypt*.
- Chang, W.-S., Pan, Y.-N., Sasaguri, N., & Matsubara, Y. (2008). Effect of C and W contents and heat treatment condition on microstructure and wear resistance of multi-component white cast irons. *Abrasion Wear Resistant Alloyed White Cast Irons For Rolling and Pulverizing Mills*, pp. 35-48.
- Coelho, G. C., Golczewski, J. A., & Fischmeister, H. F. (2003). Thermodynamic calculations for Nb-containing high-speed steels and white-cast-iron alloys. *Metallurgical and Materials Transactions A*, 34(9), 1749-1758. <https://doi.org/10.1007/s11661-003-0141-x>
- de Mello, J. D. B., & Polycarpou, A. A. (2010). Abrasive wear mechanisms of multi-components ferrous alloys abraded by soft, fine abrasive particles. *Wear*, 269(11), 911-920. <https://doi.org/10.1016/j.wear.2010.08.025>
- Doğan, Ö. N., Hawk, J. A., & Laird, G. (1997). Solidification structure and abrasion resistance of high chromium white irons. *Metallurgical and Materials Transactions A*, 28(6), 1315-1328. <https://doi.org/10.1007/s11661-997-0267-3>

- Filipovic, M., Kamberovic, Z., Korac, M., & Jordovic, B. (2013). Effect of Niobium and Vanadium Additions on the As-Cast Microstructure and Properties of Hypoeutectic Fe–Cr–C Alloy. *ISIJ International*, 53(12), 2160-2166. <https://doi.org/10.2355/isijinternational.53.2160>
- Fiset, M., Peev, K., & Radulovic, M. (1993). The influence of niobium on fracture toughness and abrasion resistance in high-chromium white cast irons. *J Mater Sci Lett*, 12(9), 615-617. <https://doi.org/10.1007/BF00465569>
- Gao, W. L., Leng, Y., Fu, D. F., & Teng, J. (2016). Effects of niobium and heat treatment on microstructure and mechanical properties of low carbon cast steels. *Materials & Design*, 105, 114-123. <https://doi.org/10.1016/j.matdes.2016.05.057>
- Gates, J., & Gore, G. J. (1995). Wear of metals: Philosophies and practicalities. *Metals forum*, 19, 53-89.
- Glaeser, W. A. (1986). Microscopy and the Study of Wear. In G. F. Vander Voort (Ed.), *Applied Metallography* (pp. 261-279). Springer US. https://doi.org/10.1007/978-1-4684-9084-8_16
- Goto, K., Matsuda, Y., Sakamoto, K., & Sugimoto, Y. (1992). Basic Characteristics and Microstructure of High-carbon High Speed Steel Rolls for Hot Rolling Mill. *ISIJ International*, 32(11), 1184-1189. <https://doi.org/10.2355/isijinternational.32.1184>
- Guesser, W. (1985). Using niobium in high-chromium irons. *Foundry management & technology*, 113(9), 50-52.
- Hashimoto, M. (2008). Development of multi-component white cast iron rolls and rolling technology in steel rolling. *Abrasion Wear Resistant Alloyed White Cast Irons For Rolling and Pulverizing Mills*, pp. 1-23.
- Hashimoto, M. (2011). Effects of Alloying Element on Compressive and Wear Properties of Multi-component White Cast irons for Steel Rolling Mill Rolls, *Abrasion Wear Resistant Alloyed White Cast Iron for Rolling and Pulverizing Mills*.

- Hashimoto, M., Kawakami, T., Oda, T., Kurahashi, R., & Hokimoto, K. (1995). Development and application of high-speed tool steel roll in hot strip rolling. *Nippon Steel Technical Report*, 66, 82-90.
- Hashimoto, M., Kubo, O., Sasaguri, N., & Matsubara, Y. (2004a). Analysis of Precipitated Carbides in Matrix of Multi-component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 76(3), 205-211. <https://doi.org/10.11279/jfes.76.205>
- Hashimoto, M., Kubo, O., & Matsubara, Y. (2004b). Analysis of Carbides in Multicomponent White Cast Iron for Hot Rolling Mill Rolls. *ISIJ International*, 44, 372-380. <https://doi.org/10.2355/isijinternational.44.372>
- Hashimoto, M., Nishiyama, Y., Sasaguri, N., & Matsubara, Y. (2006). Influence of Carbon and Vanadium on Mechanical and Hot Wear Properties of Multi-component White Cast Irons for Steel Rolling Mill Rolls. *Journal of Japan Foundry Engineering Society*, 78(5), 238-244. <https://doi.org/10.11279/jfes.78.238>
- Hashimoto, M., Nishiyama, Y., Sasaguri, N., & Matsubara, Y. (2007a). Influence of Carbon and Chromium on Mechanical and Hot Wear Properties of Multi-component White Cast Irons for Steel Rolling Mill Rolls. *Journal of Japan Foundry Engineering Society*, 79(1), 23-29. <https://doi.org/10.11279/jfes.79.23>
- Hashimoto, M., Nishiyama, Y., Yamamoto, K., Sasaguri, N., & Matsubara, Y. (2007b). Effects of Carbon and Molybdenum on Mechanical and Hot Wear Properties of Multi-component White Cast Irons for Steel Rolling Mill Roll. *Journal of Japan Foundry Engineering Society*, 79(11), 650-655. <https://doi.org/10.11279/jfes.79.650>
- Hashimoto, M., Otomo, S., Yoshida, K., Kimura, K., Kurahashi, R., Kawakami, T., & Kouga, T. (1992). Development of High-performance Roll by Continuous Pouring Process for Cladding. *ISIJ International*, 32(11), 1202-1210. <https://doi.org/10.2355/isijinternational.32.1202>

- He-Xing, C., Zhe-Chuan, C., Jin-Cai, L., & Huai-Tao, L. (1993). Effect of niobium on wear resistance of 15%Cr white cast iron. *Wear*, 166(2), 197-201.
[https://doi.org/10.1016/0043-1648\(93\)90262-K](https://doi.org/10.1016/0043-1648(93)90262-K)
- Ibrahim, M. M., El-Hadad, S., & Mourad, M. (2020). Influence of Niobium Content on the Mechanical Properties and Abrasion Wear Resistance of Heat-Treated High-Chromium Cast Iron. *International Journal of Metalcasting*, 15(2), 500-509. <https://doi.org/10.1007/s40962-020-00474-7>
- Ichino, K., Kataoka, Y., & Koseki, T. (1997). Development of centrifugal cast roll with high wear resistance for finishing stands of hot strip mill. *Kawasaki Steel Technical Report*, 37, 13–18.
- Inthidech, S., & Matsubara, Y. (2020). Effects of Carbon Balance and Heat Treatment on Hardness and Volume Fraction of Retained Austenite of Semi-multi-alloyed White Cast Iron. *International Journal of Metalcasting*, 14(1), 132-143. <https://doi.org/10.1007/s40962-019-00343-y>
- Inthidech, S., Opapaiboon, J., Yamamoto, K., & Matsubara, Y. (2021a). Three-body-type Abrasive Wear Behavior of Multi-alloyed White Cast Iron with Different Carbon Contents Used for Hot Work Rolls. *ISIJ International*, 61(11), 2832-2843. <https://doi.org/10.2355/isijinternational.ISIJINT-2021-035>
- Inthidech, S., Yamamoto, K., & Matsubara, Y. (2021b). Effect of Tungsten Equivalent on Heat Treatment Behavior of Semi-multi-alloyed White Cast Iron for Abrasive Wear Resistance. *International Journal of Metalcasting*, 15(1), 229-240. <https://doi.org/10.1007/s40962-020-00449-8>
- Ishida, K. (1995). Calculation of the effect of alloying elements on the Ms temperature in steels. *Journal of Alloys and Compounds*, 220(1), 126-131. [https://doi.org/10.1016/0925-8388\(94\)06002-9](https://doi.org/10.1016/0925-8388(94)06002-9)
- Kesri, R., & Durand-Charre, M. (1987). Phase equilibria, solidification and solid-state transformations of white cast irons containing niobium. *J Mater Sci*, 22(8), 2959-2964. <https://doi.org/10.1007/BF01086497>

- Kim, C. (1979). X-ray method of measuring retained austenite in heat treated white cast irons. *Journal of Heat Treating*, 1(2), 43-51.
<https://doi.org/10.1007/BF02833237>
- Kim, S. W., Lee, U. J., Woo, K. D., & Kim, D. K. (2003). Solidification microstructures and mechanical properties of vertical centrifugal cast high speed steel. *Materials Science and Technology*, 19(12), 1727-1732.
<https://doi.org/10.1179/026708303225008356>
- Kudo, T., Kawashima, S., & Kurahashi, R. (1992). Development of Monobloc Type High-carbon High-alloyed Rolls for Hot Rolling Mills. *ISIJ International*, 32(11), 1190-1193. <https://doi.org/10.2355/isijinternational.32.1190>
- Kurz, W., & Fisher, D. J. (1979). Dendrite growth in eutectic alloys: the coupled zone. *International Metals Reviews*, 24(1), 177-204.
<https://doi.org/10.1179/imtr.1979.24.1.177>
- Kusumoto, K., Shimizu, K., Yaer, X., Zhang, Y., Ota, Y., & Ito, J. (2017). Abrasive wear characteristics of Fe-2C-5Cr-5Mo-5W-5Nb multi-component white cast iron. *Wear*, 376-377, 22-29. <https://doi.org/10.1016/j.wear.2017.01.096>
- Laird, G., Gundlach, R., & Rohrig, K. (2000). *Abrasion-resistant cast iron handbook*. American Foundry Society.
- Lee, E.-S., Park, W.-J., Jung, J. Y., & Ahn, S. (1998). Solidification microstructure and M₂C carbide decomposition in a spray-formed high-speed steel. *Metallurgical and Materials Transactions A*, 29(5), 1395-1404.
<https://doi.org/10.1007/s11661-998-0354-0>
- Lighvan, H. P. (2021). *Development and performance evaluation of abrasion-resistant white cast irons containing macro-additions of niobium carbide* [PhD Thesis, The University of Queensland].

- Ma, Y., Li, X., Liu, Y., Zhou, S., & Dang, X. (2013). Microstructure and properties of Ti–Nb–V–Mo-alloyed high chromium cast iron. *Bulletin of Materials Science*, 36(5), 839-844. <https://doi.org/10.1007/s12034-013-0558-9>
- Maja, M. E., Maruma, M. G., Mampuru, L. A., & Moema, S. J. (2016). Effect of niobium on the solidification structure and properties of hypoeutectic high-chromium white cast irons. *Journal of the Southern African Institute of Mining and Metallurgy*, 116, 981-986.
- Matsubara, Y., Sasaguri, N., & Hashimoto, M. (1996). *The history and development of cast rolls for hot working mill* The 4th Asian Foundry Congress-Australia,
- Matsubara, Y., Sasaguri, N., Honda, Y., Wu, H.-Q., & Hashimoto, M. (1994). Solidification Structure of Multi-component White Cast Iron. *IMONO*, 66(11), 815-821. https://doi.org/10.11279/imono.66.11_815
- Matsubara, Y., Sasaguri, N., Shimizu, K., & Yu, S. K. (2001). Solidification and abrasion wear of white cast irons alloyed with 20% carbide forming elements. *Wear*, 250(1), 502-510. [https://doi.org/10.1016/S0043-1648\(01\)00599-3](https://doi.org/10.1016/S0043-1648(01)00599-3)
- Matsubara, Y., Sasaguri, N., Yokomizo, Y., & Wu, H.-Q. (1999). Continuous Cooling Transformation Behavior of Multi-Component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 71(3), 183-189. <https://doi.org/10.11279/jfes.71.183>
- Matsubara, Y., Yokomizo, Y., Sasaguri, N., & Hashimoto, M. (2000). Effect of Carbon Content and Heat-treating Condition on Retained Austenite and Hardness of Multi-component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 72(7), 471-477. <https://doi.org/10.11279/jfes.72.471>
- Meebupha, T., Inthidech, S., Sricharoenchai, P., & Matsubara, Y. (2017). Effect of Molybdenum Content on Heat Treatment Behavior of Multi-Alloyed White Cast Iron. *Materials Transactions*, 58(4), 655-662. <https://doi.org/10.2320/matertrans.M2016396>

- Melo, I., Silva, A., Silva, L., & Pinheiro, I. (2020). Effect of niobium addition on the properties and microstructure of a high chromium cast iron alloy. *Matéria (Rio de Janeiro)*, 25. <https://doi.org/10.1590/s1517-707620200002.1023>
- Mohrbacher, H., & Delagostini Jarreta, D. (2015). *Technology Properties and Applications of Niobium Carbide Reinforced Steel and Iron Alloys*.
- Morikawa, H., Tsujimoto, Y., Kimura, H., & Odan, T. (2014). *Development of High Speed Tool Steel Roll with Higher Resistance to Wear and Surface Roughening* 5th Conference on Abrasion Wear Resistant Cast Iron and Forged Steel for Rolling and Pulverizing Mills
- Opapaiboon, J., Ayudhaya, M., Sricharoenchai, P., Inthidech, S., & Matsubara, Y. (2019a). Effect of Chromium Content on Heat Treatment Behavior of Multi-Alloyed White Cast Iron for Abrasive Wear Resistance. *Materials Transactions*, 60. <https://doi.org/10.2320/matertrans.M2018318>
- Opapaiboon, J., Inthidech, S., Ozaki, K.-i., Hashimoto, M., & Matsubara, Y. (2025a). Characteristics of Fracture Mechanics in Cast Roll Materials for Steel Hot Rolling. *International Journal of Metalcasting*. <https://doi.org/10.1007/s40962-025-01664-x>
- Opapaiboon, J., Inthidech, S., Visutti pitukul, P., & Matsubara, Y. (2022). Solidification Structure and Heat Treatment Behavior of Multi-alloyed White Cast Iron with Extensive Molybdenum Content for Applying to Hot Work Rolls. *International Journal of Metalcasting*. <https://doi.org/10.1007/s40962-021-00750-0>
- Opapaiboon, J., Inthidech, S., Yamamoto, K., & Matsubara, Y. (2024). Effect of V Content on Microstructure and Heat Treatment Behavior of Multi-component White Cast Iron used for Hot Work Roll Applications. *International Journal of Metalcasting*, 18(3), 2484-2498. <https://doi.org/10.1007/s40962-023-01187-3>

- Opapaiboon, J., Inthidech, S., Yamamoto, K., & Matsubara, Y. (2025b). Effect of Carbon Balance on Structural Properties and Wear Resistance of Multi-component White Cast Iron. *International Journal of Metalcasting*.
<https://doi.org/10.1007/s40962-025-01663-y>
- Opapaiboon, J., Sricharoenchai, P., Inthidech, S., & Matsubara, Y. (2015). Effect of Carbon Content on Heat Treatment Behavior of Multi-Alloyed White Cast Iron for Abrasive Wear Resistance. *Materials Transactions*, 56.
<https://doi.org/10.2320/matertrans.M2015001>
- Opapaiboon, J., Supradist Na Ayudhaya, M., Sricharoenchai, P., Inthidech, S., & Matsubara, Y. (2019b). Effect of chromium content on the three-body-type abrasive wear behavior of multi-alloyed white cast iron. *Journal of Metals, Materials and Minerals*, 28(2).
<http://jmmm.material.chula.ac.th/index.php/jmmm/article/view/444>
- Pellizzari, M., Molinari, A., & Straffelini, G. (2005). Tribological behaviour of hot rolling rolls. *Wear*, 259, 1281-1289. <https://doi.org/10.1016/j.wear.2004.12.006>
- Penagos, J. J., Pereira, J. I., Machado, P. C., Albertin, E., & Sinatora, A. (2017). Synergetic effect of niobium and molybdenum on abrasion resistance of high chromium cast irons. *Wear*, 376-377, 983-992.
<https://doi.org/10.1016/j.wear.2017.01.103>
- Platl, J., Leitner, H., Turk, C., & Schnitzer, R. (2020). Determination of Martensite Start Temperature of High-Speed Steels Based on Thermodynamic Calculations. *Steel Research International*, 91. <https://doi.org/10.1002/srin.202000063>
- Pourasiabi, H., & Gates, J. D. (2021). Effects of niobium macro-additions to high chromium white cast iron on microstructure, hardness and abrasive wear behaviour. *Materials & Design*, 212, 110261.
<https://doi.org/10.1016/j.matdes.2021.110261>

- Pourasiabi, H., & Gates, J. D. (2022a). Effects of chromium carbide volume fraction on high-stress abrasion performance of NbC-bearing high chromium white cast irons. *Wear*, 498-499. <https://doi.org/10.1016/j.wear.2022.204312>
- Pourasiabi, H., & Gates, J. D. (2022b). Effects of matrix chromium-to-carbon ratio on high-stress abrasive wear behavior of high chromium white cast irons dual-reinforced by niobium carbides. *Tribology International*, 167. <https://doi.org/10.1016/j.triboint.2021.107350>
- Sano, Y., Hattori, T., & Haga, M. (1992). Characteristics of High-carbon High Speed Steel Rolls for Hot Strip Mill. *ISIJ International*, 32(11), 1194-1201. <https://doi.org/10.2355/isijinternational.32.1194>
- Sare, I. R. (1979). Abrasion resistance and fracture toughness of white cast irons. *Metals Technology*, 6(1), 412-419. <https://doi.org/10.1179/030716979803276228>
- Sasaguri, N., Yamamoto, K., Yokomizo, Y., Shimizu, K., & Matsubara, Y. (2010). Influence of Cobalt Content on Heat Treatment Behavior and Abrasive Wear Characteristics of Multi-Component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 82, 667-673. <https://doi.org/10.11279/jfes.82.667>
- Sasaguri, N., Yokomizo, Y., Mutaguchi, T., Hashimoto, M., & Matsubara, Y. (2005). Crystallization Behavior of Carbides in Hypereutectic Multi-component White Cast Iron with High Carbon Content. *Journal of Japan Foundry Engineering Society*, 77, 629-636. <https://doi.org/10.11279/jfes.77.629>
- Shabalin, I. L. (2019). Niobium Carbides. In I. L. Shabalin (Ed.), *Ultra-High Temperature Materials II: Refractory Carbides I (Ta, Hf, Nb and Zr Carbides)* (pp. 249-422). Springer Netherlands. https://doi.org/10.1007/978-94-024-1302-1_4
- Silva, A. E. d., Melo, I. N. R. d., Pinheiro, I. P., & Silva, L. R. d. (2021). Influence of Niobium Addition on Microstructure and Machinability of High Chromium Cast Iron. *Materials Research*, 24(5). <https://doi.org/10.1590/1980-5373-mr-2020-0429>

- Spuzic, S., Strafford, K. N., Subramanian, C., & Savage, G. (1994). Wear of hot rolling mill rolls: an overview. *Wear*, 176, 261-271.
- Kovarikova, I., Szewczykova, B., Blaskovits, P., Hodulova, E., & Lechovic, E. (2009). Study and characteristic of abrasive wear mechanisms. *Materials Science and Technology*, 1, 1-8
- Takigawa, H., Ohtomo, S., Tanaka, T., & Hashimoto, M. (1997). Development of High-Speed Tool Steel Rolls and Their Applications to Rolling Mills. *Nippon Steel Technical Report*, 74, 77-83.
- Theisen, W. (2008). Design of wear resistant alloys against abrasion. *Abrasion Wear Resistant Alloyed White Cast Irons For Rolling and Pulverizing Mills*, pp. 128-138.
- Tommy, N., & Collins, D. (2002). Developments in hot strip mill roll technology. *Abrasion Wear Resistant Alloyed White Cast Iron for Rolling and Pulverizing Mills* (pp. 11-22).
- Wu, H.-Q. (2000). *Studies on solidification structure of multi-component white cast iron*.
- Wu, H. Q., Hashimoto, M., Sasaguri, N., & Matsubara, Y. (1996). Solidification Sequence of Multi-Component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 68(8), 637-643. <https://doi.org/10.11279/jfes.68.637>
- Wu, H. Q., Sasaguri, N., Hashimoto, M., & Matsubara, Y. (1995). Type and morphology of carbides precipitated in multi-component white cast iron. *IMONO*, 67(1), 49-55. https://doi.org/10.11279/imon.67.1_49
- Wu, H. Q., Sasaguri, N., Hashimoto, M., & Matsubara, Y. (1997). Practical phase diagram of multi-component white cast iron. *Journal of Japan Foundry Engineering Society*, 69, 917-923. <https://doi.org/10.11279/jfes.69.917>

- Yarita, I. (1984). Problems of Friction, Lubrication, and Materials for Rolls in the Rolling Technology. *Transactions of the Iron and Steel Institute of Japan*, 24(12), 1014-1035. <https://doi.org/10.2355/isijinternational1966.24.1014>
- Yokomizo, Y., Sasaguri, N., & Matsubara, Y. (2000). Influence of Cobalt Content on Continuous Cooling Transformation Behavior of Multi-Component White Cast Iron. *Journal of Japan Foundry Engineering Society*, 72(4), 257-262. <https://doi.org/10.11279/jfes.72.257>
- Yu, S.-K., & Matsubara, Y. (2001). The Solidification Microstructure of X%C-5%Cr-5%V-5%Mo-5%W-5%Co Multi-Component White Cast Iron. *Korean Journal of Materials Research*, 11.
- Zhi, X., Xing, J., Fu, H., & Xiao, B. (2008). Effect of niobium on the as-cast microstructure of hypereutectic high chromium cast iron. *Materials Letters*, 62(6), 857-860. <https://doi.org/10.1016/j.matlet.2007.06.084>
- Zum Gahr, K.-H. (1987). *Microstructure and wear of materials*. Elsevier.
- Zum Gahr, K.-H., & Doane, D. V. (1980). Optimizing fracture toughness and abrasion resistance in white cast irons. *Metallurgical Transactions A*, 11(4), 613-620. <https://doi.org/10.1007/BF02670698>