Title (en)

METHOD FOR OPTIMALLY PRODUCING METAL STEEL AND IRON ALLOYS IN HOT-ROLLED AND THICK PLATE FACTORIES USING A MICROSTRUCTURE SIMULATOR, MONITOR, AND/OR MODEL

Title (de)

VERFAHREN ZUR OPTIMIERTEN HERSTELLUNG VON METALLISCHEN STAHL- UND EISENLEGIERUNGEN IN WARMWALZ- UND GROBBLECHWERKEN MITTELS EINES GEFÜGESIMULATORS, -MONITORS UND/ODER -MODELLS

Title (fr)

PROCÉDÉ DE PRODUCTION OPTIMISÉE D'ALLIAGES MÉTALLIQUES À BASE D'ACIER ET DE FER DANS DES UNITÉS DE LAMINAGE À CHAUD ET DE FABRICATION DE TÔLES FORTES AU MOYEN D'UN SIMULATEUR, MONITEUR ET/OU MODÈLE DE STRUCTURE

Publication

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Application

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Abstract (en)

[origin: WO2015110310A1] The invention relates to a method for controlling a metallurgical production system using a microstructure model, comprising a program which calculates at least one mechanical strength property of a produced product and which calculates the strength property on the basis of calculated metallurgical phase components of the microstructure of the produced product. The metallurgical system comprises a terminating cooling section, and operating parameters of the metallurgical system are incorporated when calculating the mechanical strength property with adaptable output values which have been at least partly used in advance. The aim of the invention is to provide a solution which allows an advantageous adjustment of operating parameters in order to achieve desired mechanical strength properties of the product consisting of a metal steel and/or iron alloy. This is achieved in that as the operating parameters incorporated when calculating the strength property, the respective mass proportion of at least one alloy element, which is present in the chemical composition of a metal steel and/or iron alloy being used, and at least one additional operating parameter, preferably a cooling rate which is adjusted as part of a cooling process carried out after a rolling process, are detected, and an increase of the observed strength property, said increase being achieved by changing at least said additional operating parameter, is at least partly compensated by reducing the mass proportion of one or more of the alloy elements of the metal steel and/or iron alloy being used.

IPC 8 full level

B21B 37/00 (2006.01)

CPC (source: EP KR RU US)

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Citation (opposition)

Opponent : Danieli & C Officine Meccanishe

- US 8108064 B2 20120131 - MUKHOPADHYAY ANANYA [IN]
- US 6430461 B1 20020806 - ANDORFER JOSEF [AT], et al
- US 2010131092 A1 20100527 - SCHMORS STEFAN [DE], et al
- US 2007198122 A1 20070823 - WEINZIERL KLAUS [DE]
- US 2007088524 A1 20070419 - BUERVENICH HANS-PETER [DE]
- US 6546310 B1 20030408 - DOELL RUEDIGER [DE], et al
- JP 2013066929 A 20130418 - TOSHIBA MITSUBISHI ELEC INC
- JP 2003328030 A 20031119 - JFE STEEL KK
- US 4775429 A 19881004 - MURAI TERUYUKI [JP], et al
- US 2004205951 A1 20041021 - KURZ MATTHIAS [DE], et al
- CN 1664550 A 20050907 - UNIV NORTHEASTERN [CN]
- OHIOON KWON: "A Technology for the Prediction and Control of Microstructural Changes and Mechanical Properties in Steel", ISIJ INTERNATIONAL, vol. 32, no. 3, 1992, pages 350 - 358, XP055322272
- MOHAMED I SHAHTOUT ET AL.: "Thermo- mechanical modeling of thin slab direct rolling of Nb steels", JOURNAL OF ENGINEERING MANUFACTURE, vol. 226, no. 8, 2012, pages 1346 - 1353, XP055520359
- HANS-ULRICH LOFFLER: "New Analysis- and Simulation-features of the Microstructure Monitor and First Results from Plate Mills", AISTECH 2011 PROCEEDINGS, vol. II, 2011, pages 281 - 288, XP055520365
- ANANYA MUKHOPADHYAY ET AL.: "CQE - Controlling Mechanical Properties of Hot Rolled Coil", AISTECH - CONFERENCE PROCEEDINGS, vol. 2, 2008, Pittsburgh, PA, pages 311 - 328, XP055520372
- I. MOHANTY ET AL.: "Online mechanical property prediction system for hot rolled IF steel", IRONMAKING & STEELMAKING PROCESS, PRODUCTS AND APPLICATIONS, vol. 41, no. 8, 29 January 2014 (2014-01-29), pages 618 - 627, XP055520380
- ANANYA MUKHOPADHYAY ET AL.: "Implementation Experience of DANIELI-CQETM at Hot Strip Mill", AISTECH 2010 PROCEEDINGS, vol. II, 2010, pages 859 - 867, XP055520386
- TAO JIA ET AL.: "The Optimal Design for the Production of Hot Rolled Strip with "Tight Oxide Scale" by Using Multi-objective Optimization", ISIJ INTERNATIONAL, vol. 51, no. 9, 2011, pages 1468 - 1473, XP055520391
- ANANYA MUKHOADHYAY ET AL.: "Prediction of mechanical properties of hot rolled, low-carbon steel strips using artificial neural network", MATERIALS AND MANUFACTURING PROCESSES, vol. 20, 2005, pages 793 - 812, XP055520395
- ANANYA MUKHOPADHYAY ET AL.: "DANIELI-CQE: System for Controlling Mechanical Properties of Hot-Rolled Coil", MATERIALS AND MANUFACTURING PROCESSES, vol. 25, 2010, pages 76 - 84, XP055520401
- KIYOSHI NISHIOKA ET AL.: "Progress in thermomechanical control of steel plates and their commercialization", SCIENCE AND TECHNOLOGY OF ADVANCED MATERIALS, vol. 13, 3 April 2012 (2012-04-03), XP055520407
- YOSHIYUKI WATANABE ET AL.: "Integrated Model for Microstructural Evolution and Properties of Steel Plates Manufactured in Production Line", ISIJ INTERNATIONAL, vol. 32, no. 3, 1992, pages 405 - 413, XP055520413
- ATSUHIKO YOSHIE ET AL.: "Modelling of Microstructural Evolution and Mechanical Properties of Steel Plates Produced by Thermo-Mechanical Control Process", ISIJ INTERNATIONAL, vol. 32, no. 3, 1992, pages 395 - 404, XP000609404
- TAKEHIDE SENUMA ET AL.: "Mathematical Models for Predicting Microstructural Evolution and Mechanical Properties of Hot Strip s", ISIJ INTERNATIONAL, vol. 32, no. 3, 1992, pages 423 - 432, XP055520429

- I ANANYA MUKHOPADHYAY ET AL.: "QTB Plus: Better Control for Mechanical Properties of Quenched and Tempered Bars", AISTECH 2009 PROCEEDINGS, vol. II, 2009, pages 699 - 712, XP055520432
- ANTONIO AUGUSTO GORNI ET AL.: "Accelerated Cooling of Steel Plates: The Time Has Come", JOURNAL OF ASTM INTERNATIONAL, vol. 5, no. 8, 2008, pages 1 - 7, XP055520468

Opponent : Thyssenkrupp Steel Europe AG

- WO 9818970 A1 19980507 - VOEST ALPINE IND ANLAGEN [AT], et al
- US 6309482 B1 20011030 - DORRICOTT JONATHAN [US], et al
- EP 2058060 B1 20140917 - NIPPON STEEL & SUMITOMO METAL CORP [JP]
- DE 19881711 B4 20120726 - SIEMENS AG [DE]
- DE 102007007560 A1 20080821 - SIEMENS AG [DE]
- WO 2005099923 A1 20051027 - SIEMENS AG [DE], et al
- U. LOTTER ET AL.: "Structure of the metallurgical oriented modelling system TK-StripCAM for simulation of hot strip manufacture and application in research and production practice", J. PHYS., vol. 120, 2004, pages 801 - 808, XP055521349
- ILSE HECKELMANN: "Dynamische Fertigungssteuerung: Neue Präzision in der Stahlerzeugung", ZUSAMMENFASSUNG DES REFERATS, 20 November 2008 (2008-11-20), XP055521355
- "Von der Prozessoptimierung zum Hochleistungsstahl", KONSTRUKTION, January 2009 (2009-01-01), XP055521363
- "Primus Stahl: Hart und smart", FACHPRESSEFORUM WERKSTOFFE BEI THYSSENKRUPP STEEL BLECH INFORM, June 2008 (2008-06-01), pages 54 - 55, XP055521371

Cited by

EP4375893A1; DE102021211320A1; WO2023057614A1; DE102020214532A1; WO2022106097A1

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