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(54) Method for treating a metal element for an automobile

Verfahren zur Behandlung eines Metallelements für ein Automobil

Procédé de traitement d'un élément métallique pour une automobile

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EP 2 369 020 B1

Description

[0001] The invention refers to a method for treating a metal element for an automobile.

[0002] A metal element can be a component of the automobile body or automobile frame made out of a metal sheet as well as a massive metal element of the automobile, such as a bolt, a spring or another massive component not made out of a metal sheet. The metal element has to have a high strength and good anti-corrosive qualities.

[0003] For increasing the metal element strength, the metal element is heated in an oven to a temperature of 550°C to 1200°C, and is subsequently quickly cooled down to a temperature below 220°C in an oil bath or by cooled air. In a so called press-hardening process, the metal element is heated to a temperature of 800°C to 1000°C and is formed into its end shape by pressing and cooled in a press subsequent to the heating. The hardened metal element has a very high strength and allows to produce relatively light metal elements for the automobile. Subsequent to the hardening, the hardened high strength metal element is made anti-corrosive by means of a surface treatment or a surface coating step.

[0004] On the way from the hardening oven to the oil bath or to the press, the heated metal element is, because the high temperature difference with the environment, subject to scaling so that the scale has to be removed from the metal element before the metal element is passed to the surface treatment or surface coating step. A classic method for scale removing is pickling in a cleaning liquid with a strong acid, for example with sulphuric acid. With this scale removing method, even the smallest structures, such as slits, hollow spaces, undercuts etc. are removed from scale. But using a strong acid has the disadvantage that the treated high strength metal element becomes brittle. An alternative method for scale removing is shot blasting which does not effect the inner structure of the metal element but is not suitable to remove scale from small structures, slits, undercuts etc. In addition, the shot blasting stream can mechanically deform a sheet-made metal element.

[0005] US 2006/02019334 A1 discloses a cleaning of a press-hardened component blank by dry-cleaning prior to the coating step.

[0006] US 2006/0131185 A1 discloses a treatment of gears hardened by heat treating techniques in an ultrasound bath for cleaning and dehydration.

[0007] It is an object of the invention to improve the scale removing from a automobile metal element between the hardening step and the subsequent coating step.

[0008] This object is, according to the invention, solved with the features of claim 1.

[0009] According to claim 1, the metal element is first hardened. The hardening step can be accomplished by heating the metal element in an oven to a temperature of about 550°C to 1200°C. After heating, the metal ele-

ment is quickly cooled down to a temperature below 200°C in an oil bath or by cooled air. On the way from the heating oven to the oil bath or to a press for providing a press-hardening step, the metal element is subject to scaling.

[0010] Subsequently to the hardening step, the scale removing step is provided by an ultrasonic process, whereby the ultrasonic liquid is a water solution with an organic carboxylic with the concentration of 0,1 to 10 vol. %.

[0011] As experiments have shown, such a water solution does not significantly affect the metal elements surface, and in particular does not make the metal element brittle. On the other hand, the ultrasonic cleaning method guarantees that the scale is completely removed even from small structures, slits, hollow spaces, undercuts etc.

[0012] Subsequent to the scale removing step, the metal element is coated in a coating process with an anticorrosion coating. This coating process can be realized, for example, by a so-called thermo diffusion process with zinc powder.

[0013] According to the preferred embodiment of the invention, the organic carboxylic acid concentration is between 1,0 and 6,0 vol. %, and preferably between 2,0 and 6,0 vol. %. According to a preferred embodiment, the organic carboxylic acid is a citric acid.

[0014] Preferably, the ultrasonic liquid has a pH value between 3,0 and 5,0.

[0015] According to a preferred embodiment of the invention, is the ultrasonic frequency during the ultrasonic cleaning sequence is between 18 kHz and 60 kHz, whereby the ultrasonic frequency can be a varied during the complete ultrasonic scale removing sequence. Preferably, the ultrasonic activity is provided in intervals with numerous interruptions of less than 30% during the ultrasonic process step. The scale removing sequence can take between one and eight minutes.

[0016] Preferably, the temperature of the ultrasonic liquid is between 30 and 70°C. In this temperature range, the ultrasonic liquid is very effective.

[0017] According to a preferred embodiment of the invention, the metal element is moved with respect to the ultrasonic liquid during the ultrasonic cleaning sequence. Preferably, the metal element is rotated in the ultrasonic liquid during the ultrasonic treatment. Preferably, the metal element is rotated by a rotor in the ultrasonic liquid during the ultrasonic treatment. The rotor holds the metal element in a rotor cradle or with rotor fingers attached to the metal element.

[0018] Preferably, the metal element is a complex structural automobile element.

[0019] The following is a description of one embodiment of the method according to the invention.

[0020] A metal element to be treated can be any metal automobile component which has to have high strength and good anticorrosive qualities. Especially automobile components made out of thin metal sheets but also massive parts as springs and bolts are predestinated to be

treated accordingly. The following example refers to a sheet-like metal element which is formed to a component of the automobile body or automobile frame.

[0021] In a hardening step, the metal sheet element is transferred to a hardening oven wherein the metal sheet element is heated to a temperature of 700°C to 1000°C in an oven, and subsequently is formed into its end shape by pressing under high pressure in a press-hardening press. As soon as the heated metal sheet element is removed from the oven, the metal sheet element is subject to scaling on the way to the press so that the metal sheet element is covered with a layer of scale after leaving the press-hardening oven. After the press-hardening step in the press, the press is opened, and the metal sheet element is removed from the press.

[0022] Before the metal sheet element is transferred to a coating step for coating the high strength metal sheet element with an anticorrosion coating, the scale layer has to be removed from the metal sheet element.

[0023] The scale removing step is carried out in a scale removing device, wherein the high strength metal sheet element is fixed to a rotor which rotates the metal sheet element in an ultrasonic liquid. The ultrasonic liquid is a water solution with an organic carboxylic acid with a concentration of about 4,0 vol%. Preferably, the acid is a citric acid. The ultrasonic liquid has a temperature of about 50°C and a pH value of 4.

[0024] As soon as the metal sheet element is fixed to the rotor and immersed into the ultrasonic liquid, the scale removing process starts: an ultrasonic element induces ultrasonic waves into the ultrasonic liquid. The frequency of the ultrasonic waves varies between 20 kHz and 40 kHz, and is provided in intervals of for example 50 seconds separated by interruptions of 10 seconds. During the complete ultrasonic treatment step, the metal sheet element is rotated by the rotor in the ultrasonic liquid. The ultrasonic treatment of one metal sheet element takes about 5 minutes in total.

[0025] After the scale removing step is finished, the metal sheet element is removed from the ultrasonic scale removing device, and is transferred to a coating process step whereby the metal sheet element is provided with an anticorrosion treatment by a so-called thermo diffusion process with zinc powder.

Claims

1. Method for treating a metal element for an automobile, with the steps:

hardening the metal element,
removing scale from the hardened metal element in an ultrasonic liquid by an ultrasonic process, whereby the ultrasonic liquid is a water solution with an organic carboxylic acid with a concentration of 0,1 to 10 vol. %, and
coating the metal element in a coating process

with an anticorrosion coating.

2. Method for treating a metal element of claim 1, wherein the hardening step is realized by press-hardening.
3. Method for treating a metal element of one of the preceding claims, wherein the organic carboxylic acid concentration is between 1,0 and 8,0 vol.%.
4. Method for treating a metal element of one of the preceding claims, wherein the organic carboxylic acid concentration is between 2,0 and 6,0 vol.%.
5. Method for treating a metal element of one of the preceding claims, wherein the organic carboxylic acid is a citric acid.
6. Method for treating a metal element of one of the preceding claims, wherein the ultrasonic liquid has a pH-value between 3,0 and 5,0.
7. Method for treating a metal element of one of the preceding claims, wherein the ultrasonic frequency during the ultrasonic process step is between 18 kHz and 60 kHz.
8. Method for treating a metal element of one of the preceding claims, wherein the ultrasonic frequency is varied during the complete ultrasonic process step.
9. Method for treating a metal element of one of the preceding claims, wherein the ultrasonic activity is provided in intervals with numerous interruptions of less than 30% during the ultrasonic process step.
10. Method for treating a metal element of one of the preceding claims, wherein the cleaning sequence takes 1 to 8 minutes.
11. Method for treating a metal element of one of the preceding claims, wherein the temperature of the ultrasonic liquid is between +30 and +70°C.
12. Method for treating a metal element of one of the preceding claims, wherein the metal element is moved with respect to the ultrasonic liquid during the ultrasonic process step.
13. Method for treating a metal element of one of the preceding claims, wherein the metal element is rotated in the ultrasonic liquid during the ultrasonic process step.

14. Method for treating a metal element of one of the preceding claims, wherein the metal element is rotated by a rotor in the ultrasonic liquid during the ultrasonic process step.
15. Method for treating a metal element of one of the preceding claims, wherein the metal element is a complex structural automobile element which is hardened by press-hardening.
16. Method for treating a metal element of one of the preceding claims, wherein the metal element is a massive element which is hardened by heating and subsequently cooling in an oil bath.
17. Method for treating a metal element of one of the preceding claims, wherein the coating is realized by a thermal-diffusion procedure with zinc powder.

Patentansprüche

1. Verfahren zum Behandeln eines Metallelements für ein Automobil mit den Schritten:

Härten des Metallelements,
Entzundern des gehärteten Metallelements in einer Ultraschall-Flüssigkeit mit einem Ultraschallverfahren, wobei die Ultraschall-Flüssigkeit eine wässrige Lösung mit einer organischen Carbonsäure in einer Konzentration von 0,1 bis 10 Vol.-% ist, und
Beschichten des Metallelements mit einer Korrosionsschutzschicht in einem Beschichtungsverfahren.

2. Verfahren zum Behandeln eines Metallelements nach Anspruch 1, wobei der Härtungsschritt durch Presshärten durchgeführt wird.
3. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Konzentration der organischen Carbonsäure zwischen 1,0 und 8,0 Vol.-% beträgt.
4. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Konzentration der organischen Carbonsäure zwischen 2,0 und 6,0 Vol.-% beträgt.
5. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die organische Carbonsäure eine Zitronensäure ist.
6. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Ultraschall-Flüssigkeit einen pH-Wert zwischen 3,0 und 5,0 hat.

7. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Ultraschallfrequenz während des Ultraschallverfahrensschritts zwischen 18 kHz und 60 kHz beträgt.

8. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Ultraschallfrequenz während des gesamten Ultraschallverfahrensschritts verändert wird.

9. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Ultraschallaktivität in Intervallen mit zahlreichen Unterbrechungen von weniger als 30% während des Ultraschallverfahrensschritts bereitgestellt wird.

10. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Reinigungssequenz 1 bis 8 Minuten dauert.

11. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Temperatur der Ultraschallflüssigkeit zwischen +30 und +70°C beträgt.

12. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei das Metallelement während des Ultraschallverfahrensschritts in Bezug auf die Ultraschallflüssigkeit bewegt wird.

13. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei das Metallelement während des Ultraschallverfahrens in der Ultraschallflüssigkeit gedreht wird.

14. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei das Metallelement während des Ultraschallverfahrens durch einen Rotor in der Ultraschallflüssigkeit gedreht wird.

15. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei das Metallelement ein komplexes Automobilstrukturelement ist, welches durch Presshärten gehärtet wird.

16. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei das Metallelement ein massives Element ist, welches durch Erwärmen und anschließendes Abkühlen in einem Ölbad gehärtet wird.

17. Verfahren zum Behandeln eines Metallelements nach einem der vorhergehenden Ansprüche, wobei die Beschichtung durch ein Thermodiffusionsverfahren mit Zinkpulver verwirklicht wird.

Revendications

1. Procédé de traitement d'un élément métallique pour une automobile, comprenant les étapes suivantes :

durcir l'élément métallique,
éliminer la calamine de l'élément métallique durci dans un liquide ultrasonique à l'aide d'un processus ultrasonique, le liquide ultrasonique étant une solution aqueuse avec un acide carboxylique organique présentant une concentration de 0,1 à 10 % vol., et
revêtir l'élément métallique dans un processus de revêtement avec un revêtement anticorrosion.
2. Procédé de traitement d'un élément métallique selon la revendication 1, dans lequel l'étape de durcissement est réalisée par trempe sous presse.
3. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la concentration d'acide carboxylique organique se situe entre 1,0 et 8,0 % vol.
4. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la concentration d'acide carboxylique organique se situe entre 2,0 et 6,0 % vol.
5. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'acide carboxylique organique est un acide citrique.
6. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel le liquide ultrasonique présente un pH entre 3,0 et 5,0.
7. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la fréquence ultrasonique pendant l'étape du processus ultrasonique se situe entre 18 kHz et 60 kHz.
8. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la fréquence ultrasonique est variée pendant l'étape complète du processus ultrasonique.
9. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'activité ultrasonique est fournie par intervalles avec de nombreuses interruptions inférieures à 30 % pendant l'étape du processus ultrasonique.
10. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la séquence de nettoyage prend de 1 à 8 minutes.
11. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel la température du liquide ultrasonique se situe entre +30 °C et +70 °C.
12. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'élément métallique est déplacé par rapport au liquide ultrasonique pendant l'étape du processus ultrasonique.
13. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'élément métallique est mis en rotation dans le liquide ultrasonique pendant l'étape du processus ultrasonique.
14. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'élément métallique est mis en rotation par un rotor dans le liquide ultrasonique pendant l'étape du processus ultrasonique.
15. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'élément métallique est un élément automobile structural complexe qui est durci par trempe sous presse.
16. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel l'élément métallique est un élément massif qui est durci en le chauffant et ensuite en le refroidissant dans un bain d'huile.
17. Procédé de traitement d'un élément métallique selon l'une des revendications précédentes, dans lequel le revêtement est réalisé par un procédé de diffusion thermique avec de la poudre de zinc.

REFERENCES CITED IN THE DESCRIPTION

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