Abstract:
In a process for descaling a workpiece (22), in particular rolling stock, the workpiece is moved past rotary descaling means, and at least one liquid jet which rotates around an axis of rotation that crosses the surface (23) to be descaled of the workpiece (22) is projected onto the surface (23) to be descaled. In order to cool down the workpiece (22) only to a minor extent and to generate a high spraying pressure with a low working liquid pressure, the liquid jet is intermittently generated, i.e. interrupted at intervals.
(54) Title: WORKPIECE DESCALING PROCESS

(54) Bezeichnung: VERFAHREN ZUM ENTZUNDERN EINES WERKSTÜCKES

(57) Abstract

In a process for descaling a workpiece (22), in particular rolling stock, the workpiece is moved past rotary descaling means, and at least one liquid jet which rotates around an axis of rotation that crosses the surface (23) to be descaled of the workpiece (22) is projected onto the surface (23) to be descaled. In order to cool down the workpiece (22) only to a minor extent and to generate a high spraying pressure with a low working liquid pressure, the liquid jet is intermittently generated, i.e. interrupted at intervals.

(57) Zusammenfassung

Bei einem Verfahren zum Entzundern eines Werkstückes (22), insbesondere eines Walzgutes, wird das Werkstück an einer Rotor-Entzunderneinrichtung vorbeibewegt und bei dieser mindestens ein Flüssigkeitsstrahl, der um eine die zu entzundernde Oberfläche (23) des Werkstückes (22) schneidende Rotationsachse rotiert, auf die zu entzundernde Oberfläche (23) gespritzt. Zur Erstellung einer nur geringen Abkühlung des Werkstückes (22) und zur Erzeugung hoher Strahlldrücke bei geringem Betriebsflüssigkeitsdruck wird der Flüssigkeitsstrahl intermittierend, d.h. zeitweilig aussetzend, gebildet.
Process for descaling a workpiece

The invention relates to a process for descaling a workpiece, particularly a rolled piece, wherein the workpiece is moved past a rotor descaling device, where at least one liquid jet rotating on a rotational axis intersecting the workpiece surface to be descaled is sprayed onto the surface to be descaled, with the liquid jet being formed intermittently, i.e. with temporary interruptions, with the liquid jet being formed intermittently, i.e. with temporary interruptions, and to a rotor descaling device for implementing the process.

Rotor descaling devices are known, for example, from DE-A-43 28 303 or EP-A-0586 823 or DE-A-31 25 146. These known rotor descaling devices are equipped with spray nozzles which are located at rotating beams or rotating nozzle holders and directed towards the workpiece surface to be descaled. As a rule, the rotational axis is perpendicular to the workpiece surface to be descaled.

In this process, liquid admission patterns are formed by individual spray curves in the form of intertwined cycloids according to the relative motion between the workpiece and the rotating spray nozzles, which is dependent on the movement of the workpiece and the nozzle speed, as well as according to the number of nozzles. As a result, liquid jets are repeatedly admitted to one and the same workpiece surface. The disadvantage of this process is that the consumption of sprayed liquid is very high and, thus, the workpiece cools to a lower temperature than actually required for descaling.

A process for spraying the liquid jets onto the workpiece surface at an inclination against the moving direction of the workpiece is known from EP-A-0 640 413. According to this document, this process is implemented by covering the liquid jet over that part of its rotational motion which does no longer meet the requirement of being directed against the moving direction of the workpiece. This process also involves high liquid consumption even though not the total amount of liquid strikes the workpiece.
Rotor descaling devices of the aforementioned type are already known from US-A 5,220,935 and DE-A 23 55 893, according to which liquid consumption can be reduced by applying an intermittent liquid jet. Furthermore, double admission of liquid jets onto workpiece surfaces and, thus, unnecessary undercooling of the rolled piece, particularly with a view to a subsequent rolling process, is avoided.

However, this embodiment does not yet allow optimum descaling of a workpiece at minimum liquid consumption.

A special effect of the process according to the invention is that pressure peaks occur which are caused by single or repeated interruption of the liquid jet and lead to elevated jet pressures. As a result, the descaling effect is essentially improved. The pressures of the liquid jets assume peak values amounting to a multiple of the constant jet pressures known from conventional processes. According to the invention, the impact pressures of the liquid jets on the surface of the workpiece are so high that the liquid pressure can be considerably lowered and an improved descaling effect is achieved.

The object of the invention is to avoid the described disadvantages and difficulties and to develop a process and a device for implementing the process where the effect of elevated jet pressures resulting from intermittent formation of the liquid jet is enhanced and distributed over the surface of the workpiece. Furthermore, optimum descaling at minimum liquid consumption is to be achieved. Particularly, not only a reduction of liquid consumption but also of the liquid pressure is to be achieved without any deterioration of the quality of the surfaces to be descaled.

In a first aspect, the invention provides a process for descaling a surface of a workpiece, wherein the workpiece is moved past a rotor descaling device, where at least one liquid jet rotating on a rotational axis intersecting the surface of the workpiece is sprayed onto the surface, with the liquid jet being formed intermittently, characterized in that the intermittent formation of the liquid jet occurs at least twice in succession, over a maximum liquid jet rotation of 10°, preferably 5°.
In another aspect, the invention provides a device for descaling a surface of a workpiece, the device producing at least one liquid jet, the device comprising a liquid supply line, a stator and a rotor which is mounted for rotation with reference to the stator and provided with at least one nozzle from which the liquid jet is produced, characterized in that the rotor is rotatable around a rotational axis intersecting the surface of the workpiece, and that between the rotor and the stator an interrupting device is located, which allows intermittent supply of liquid from the liquid supply line to the nozzle.

In another aspect, the invention provides a process for descaling a surface of a workpiece to be descaled, wherein the workpiece is moved past a rotor descaling device, the rotor descaling device comprising a liquid supply line for a pressurized liquid, a stator, a rotor and a liquid flow interrupting device, the rotor being mounted for rotation relative to the stator, the process comprising:

providing at least one nozzle on the rotor for producing a liquid jet with the pressurized fluid, the rotor and the liquid jet produced by the nozzle being rotatable around a rotational axis intersecting the surface of the workpiece;

bringing the rotor and the nozzle into rotation;

supplying the pressured fluid through the liquid supply line; and

intermittently spraying the surface of the workpiece with the liquid jet in dependence on angular positions of the rotor with reference to the interrupting device.
In this process, the liquid jets are expediently simultaneously formed.

A rotor descaling device for implementing the process according to the invention with a liquid supply line to a stator and a rotor which is pivoted compared with the stator and equipped with at least one nozzle for the formation of a liquid jet is characterized in that an interrupting device is provided between the rotor and stator which allows intermittent liquid supply to a nozzle.

The interrupting device is expediently comprised of a stationary plate cam which is rigidly fixed compared with the stator and provided with at least one control port to allow liquid passage to the nozzle which is limited in time.

A preferred embodiment is characterized in that
- the liquid supply line leads into a liquid chamber located at the rotor,
- the rotor is provided with a port through which the liquid is conveyed to the nozzle,
- one mouth of the port leads into the liquid chamber, and
- the port can be intermittently closed by means of the plate cam and is cleared when the mouth of the port is in congruent position with the control port.

A solution providing for a simple design is characterized in that a plurality of ports is provided and that each port leads to one nozzle each of the rotor, at least two mouths of the ports leading into the liquid chamber at different radial distances from the rotational axis of the rotor and the plate cam being provided with a control port corresponding to a mouth of a port and allowing liquid passage from the liquid chamber to the port.

Several control ports are expediently provided at identical radial distances from the rotational axis of the rotor, the control ports located at identical radial distances from the rotational axis of the rotor being advantageously combined in groups.

If a liquid jet is to be maintained over a slightly longer distance, i.e. not only in specific points, one control port is designed as a control slot extending in circumferential direction of the plate cam according to a preferred embodiment.
It is particularly advantageous to design the nozzles as circular-section jet nozzles because higher jet pressures compared with flat-jet nozzles can be achieved thereby since the jet is only minimally widened at circular-section jet nozzles.

The invention is explained in greater detail by several embodiments shown in the following drawing, where Fig. 1 schematically represents a section through a rotor descaling device, this section being passed through the rotational axis. Fig. 2 displays a view of the rotor descaling device in the direction of arrow II, Fig. 3 displays a partial top view of the rotor hub according to line III-III of Fig. 1, Fig. 4 displays a top view of a plate cam according to arrow IV of Fig. 1, Fig. 5 displays a spray pattern on a rolled piece represented in top view, and Fig. 6 illustrates the use of rotor descaling devices according to the invention for particularly wide workpieces, such as continuously cast slabs, etc.

In rotor descaling device 1, rotor 4, which is pivoted in gear housing 2 on rotational axis 3, is supported above bearing 6 with its rotor shaft 5. To rotor shaft 5, driving pinion 7 meshing with a rotor drive not represented in detail is mounted. At the end of rotor shaft 5 projecting outwards from gear housing 2 rotor hub 8 is located, which is provided with brackets 9 which radially extend outwards and which carry spray nozzles 10. According to the represented embodiment, twelve brackets 9 which are equally distributed along the circumference of rotor hub 8, are provided, one bracket 9 each being equipped with spray nozzle 10. Spray nozzles 10 are designed as circular-section jet nozzles and are connected with a line to port 11 which extends radially inwards from spray nozzle 10 through bracket 9 and rotor hub 8.

Rotor shaft 5 is of hollow design and interspersed by hollow tube 12, the so-called stator. This stator 12 projects from gear housing 2 with one end 13, with which is it connected to a fluid line 14, such as a high-pressure water line. Between stator 12 and rotor shaft 5 or rotor hub 8, through which stator 12 projects, liquid seals 15 are provided. At end 16 of stator 12 projecting outwards through rotor hub 8 plate cam 17 with control ports 18, 18', 18" is mounted, which is permanently connected with stator 12. Both plate cam 17 and stator 12 are covered with cover 20 tightly fixed to rotor 8, forming a liquid chamber 19 (high-pressure liquid chamber).
As can be particularly inferred from Fig. 4, control ports 18, 18', 18" of the plate cam are located at different radial distances \( r_1, r_2 \) and \( r_3 \) to rotational axis 3 of rotor shaft 5, radial distances \( r_1 \) to \( r_3 \) being selected in a way that control ports 18 to 18" can be aligned to mouths 21, 21', 21" of ports 11 shown in Fig. 3, which are located inside the rotor. This means that ports 11 also extend inwards up to different radial distances \( r_1 \) to \( r_3 \) from rotational axis 3 of rotor shaft 5.

According to plate cam 17 displayed in Fig. 4, several control ports 18, 18', 18" are provided at identical radial distances \( r_1 \) to \( r_3 \) of rotational axis 3 of rotor 4. These control ports may also be combined in groups, as shown in Fig. 4 for ports 18" which are provided at the shortest radial distance \( r_1 \) but may also be designed as bores only, so that at a rotation of rotor hub 8 on rotational axis 3, inside mouths 21 to 21" of ports 11 align only shortly with control ports 18, 18', 18" of plate cam 17, which is idle during rotation.

According to Fig. 4, control ports 18, 18', 18" are designed as slots so that mouths 21 to 21" of ports 11, which are located inside the rotation head, are aligned with control ports 18, 18', 18" over an extended rotational range.

Rotor descaling device 1 has the following function:

While workpiece 22—according to Fig. 5, for example, a rolled plate and a plate yet to be rolled—with its surface 23 to be descaled is being moved on level 24 (cf. Fig. 6) past rotor descaling device 1, whose rotational axis 3 is approximately vertical to this level 24, liquid chamber 19 is pressurized with the liquid to be sprayed on workpiece surface 23 and rotor 4, i.e. rotor shaft 5 including rotor hub 8, is caused to rotate, whereby different ports 11 come into line contact with liquid chamber 19 by means of plate cam 17 so that one or several nozzles 10 are supplied with fluid and, consequently, liquid jets are formed.

The liquid jet is formed as long as control port 18, 18', 18" is linewise connected with the corresponding port 11. If this connection is interrupted, the liquid jet is also interrupted and does not form again until the next control port 18, 18', 18"—or the same control port after a rotation through 360°—is again linewise connected with port 11. As a result, an intermittent liquid jet is formed.
Plate cam 17, which is rigidly fixed to stator 12, thus forms an interrupting device which interrupts the liquid supply to one nozzle 10 each at intervals.

An appropriate arrangement of control ports 18, 18', 18" allows producing a spray pattern as shown, for example, in Fig. 5. Circular lines 25 illustrate the intermittent liquid jets striking workpiece surface 23 while the latter is being moved past rotor descaling device 1 in accordance with the feeding device represented by arrow 26.

When plate cam 17 according to Fig. 4 is used, the outermost section $a_2$ of circular line 25 is supplied by one nozzle 10 each, which are located at the largest radial distance $r_3$ from rotational axis 3 of rotor 4 through control slots 18.

Sections $a_2$ located adjacent to center line 27 of workpiece 22 are supplied by nozzles 10 through control ports 18' which are located at a mean distance $r_2$ from rotational axis 3, and the three central sections $a_1$ are formed at three closely adjoining control slots 18" which are located at the shortest distance $r_1$ from rotational axis 3 of rotor 4.

It is essential to provide stationary circular arc sections according to Fig. 5 $a_1$ to $a_3$ (at zero feed of the workpiece), i.e. the position of the sections from $a_1$ to $a_3$ is not changed in the direction of rotation because the plate cam is idle.

Fig. 6 illustrates the arrangement of several rotor descaling devices 1 for large workpiece surfaces 23 as occurring, for example, with slabs or wide strips.

The invention is not limited to the embodiment shown in the drawing but can be modified in various aspects. For example, nozzles 10 can be located at different radial distances from rotational axis 3 of rotor 4, and control ports 18, 18', 18" can be arranged in a way that liquid can be fed to several nozzles 10 at the same time or to nozzles 10 individually one after another.

Groups of nozzles can have different nozzle diameters or can be comprised of different nozzle types. As a result, the water supply over the cross section of the workpiece to be descaled can be kept constant.
CLAIMS.

1. A process for descaling a surface of a workpiece, wherein the workpiece is moved past a rotor descaling device, where at least one liquid jet rotating on a rotational axis intersecting the surface of the workpiece is sprayed onto the surface, with the liquid jet being formed intermittently, characterized in that the intermittent formation of the liquid jet occurs at least twice in succession, over a maximum liquid jet rotation of 10°.

2. The process according to claim 1, characterized in that several liquid jets are formed, each liquid jet being formed by means of a separate nozzle and, during one rotation, being allocated to a separate partial area of the surface of the workpiece.

3. The process according to claim 2, characterized in that the liquid jets are simultaneously formed.

4. The process according to any one of claims 1 to 3, wherein the workpiece is a rolled piece.

5. The process according to any one of claims 1 to 4, wherein the maximum jet rotation is 5°.

6. A device for descaling a surface of a workpiece, the device producing at least one liquid jet, the device comprising a liquid supply line, a stator and a rotor which is mounted for rotation with reference to the stator and provided with at least one nozzle from which the liquid jet is produced, characterized in that the rotor is rotatable around a rotational axis intersecting the surface of the workpiece, and that between the rotor and the stator an interrupting device is located, which allows intermittent supply of liquid from the liquid supply line to the nozzle.
7. The device according to claim 6, characterized in that the interrupting device comprises of a plate cam which is rigidly fixed to the stator and provided with at least one control port.

8. The device according to claim 7, characterized in that
   - the liquid supply line leads into a liquid chamber adjacent to the rotor,
   - the rotor is provided with a supply port for each nozzle, the supply port conveying the liquid from an inlet mouth to the corresponding nozzle,
   - the mouth of each supply port is in fluid communication with the liquid chamber, and
   - each supply port can be intermittently closed by means of the plate cam and is open when its mouth is in congruent position with the control port.

9. The device according to claim 8, characterized in that there are several supply ports, the mouth of at least two of the supply ports being at different radial distances from the rotational axis of the rotor.

10. The device according to claim 9, characterized in that there are several control ports, at least some of them being on regularly-spaced radii from the rotational axis of the rotor.

11. The device according to claim 10, characterized in that at least some of the control ports are located on the same radius from the rotational axis of the rotor and are combined in groups of adjacent control ports.

12. The device as claimed in any one of claims 7 to 11, characterized in that at least one of the control ports extends in a circumferential direction of the plate cam.

13. The device as claimed in any one of claims 6 to 12, characterized in that each nozzle is a circular-section jet nozzle.
14. A process for descaling a surface of a workpiece to be descaled, wherein the workpiece is moved past a rotor descaling device, the rotor descaling device comprising a liquid supply line for a pressurized liquid, a stator, a rotor and a liquid flow interrupting device, the rotor being mounted for rotation relative to the stator, the process comprising:

providing at least one nozzle on the rotor for producing a liquid jet with the pressurized fluid, the rotor and the liquid jet produced by the nozzle being rotatable around a rotational axis intersecting the surface of the workpiece;

bringing the rotor and the nozzle into rotation;

supplying the pressured fluid through the liquid supply line; and

intermittently spraying the surface of the workpiece with the liquid jet in dependence on angular positions of the rotor with reference to the interrupting device.

15. The process according to claim 14, wherein several nozzles are present, each producing one corresponding liquid jet to descale a separate area on the surface of the workpiece.

16. The process according to claim 15, wherein the liquid jets are simultaneously formed.

17. The process according to any one of claims 14 to 16, wherein the interrupting device comprises a plate cam which is rigidly fixed to the stator, the plate cam being provided with at least one control port to allow passage, limited in time, of the pressured liquid toward each nozzle.
18. The process according to claim 17, wherein the liquid supply line leads into a liquid chamber provided adjacent to the rotor, each nozzle receiving the pressurized liquid through a corresponding supply port located within the rotor, the supply port being intermittently closed, as the rotor rotates, by means of the plate cam and is open when an inlet mouth of the supply port is in congruent position with the control port of the plate cam.

19. The process according to claim 18, wherein there are several supply ports and nozzles in the rotor, each supply port leading to one corresponding nozzle of the rotor, at least two of the supply ports having respective inlet mouths in fluid communication with the liquid chamber, the inlet mouths being at different radial distances from the rotational axis of the rotor.

20. The process according to claim 19, wherein there are several control ports, at least some of which are disposed in accordance with a regular radial spacing from the rotational axis of the rotor.

21. The process according to claim 18, wherein there are several control ports in the plate cam, at least some of the control ports being combined in a group of control ports located on a same radius with reference to the rotational axis of the rotor.

22. The process as claimed in any one of claims 17 to 21, wherein each control port is designed as a slot extending in a circumferential direction on the plate cam.

23. The process as claimed in any one of claims 14 to 22, characterized in that each nozzle has a circular cross section.

24. The process as claimed in any one of claims 14 to 23, wherein the workpiece is a rolled piece.