TC3 | ENGLISH TRANSLATION

Manufacture of wide titanium alloy sheet

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Full technical reference translation

This English edition includes the source abstract, description, claims, all examples, and all tables and drawings present in the technical disclosure. Machine-assisted source text has been reviewed and edited against the Chinese publication. English translation is for reference; the original Chinese publication controls. It is not a certified translation, purchase specification, material certificate, production licence or TiHubs performance guarantee. Original disclosure statements are retained as historical statements, not independently verified current claims.

Abstract

The invention discloses a preparation method for wide titanium-alloy sheet: (1) stack four to six titanium-alloy plates and enclose and weld them into a rolling pack; (2) roll the pack on a 2800 mm four-high reversing hot mill; (3) stress-relief anneal, then shear and open the pack to obtain sheet 1.0-2.5 mm thick; (4) grind the surfaces and cold-roll on a 1780 mm six-high reversing mill, then perform finishing operations to obtain sheet 0.6-2.0 mm thick and 1000-1500 mm wide.

Combining clad-pack rolling and cold rolling gives a cold-rolled surface, uniform microstructure and good surface quality.

Description

A kind of preparation method of titanium alloy wide sheet

Technical field

The invention belongs to technical field of board processing, be specifically related to a kind of preparation method of titanium alloy wide sheet.

Background technology

As aerospace and shipbuilding technologies develop, demand for wide titanium-alloy sheet continues to increase. Common plate thinner than 4 mm currently has width no greater than 1000 mm. Existing processing methods are unsuitable for wide sheet, defined here as 0.6-2.0 mm thick and 1000-1500 mm wide.

Summary of the invention

The invention addresses this deficiency by providing a preparation method for titanium-alloy sheet 0.6-2.0 mm thick and 1000-1500 mm wide. Combining clad-pack rolling with cold rolling yields a cold-rolled surface, uniform microstructure and good surface quality.

For solving the problems of the technologies described above, the technical scheme that the present invention adopts is: a kind of preparation method of titanium alloy wide sheet is characterized in that this

method may further comprise the steps:

Step 1. Stack four to six titanium-alloy plates, each 5-10 mm thick and 1000-1500 mm wide, and enclose and weld them into a rolling pack.

Step 2. Use a 2800 mm four-high reversing hot mill to roll the pack for 6-12 passes, starting at 880-950 degrees C, with total reduction not less than 60%.

Step 3. Stress-relief anneal the rolled pack, then shear and open it to obtain titanium-alloy sheet 1.0-2.5 mm thick.

Step 4. Grind the sheet surfaces to remove scale. Cold-roll on a 1780 mm six-high reversing mill for 15-30 passes, then perform finishing operations to obtain sheet 0.6-2.0 mm thick and 1000-1500 mm wide. Cold reduction per pass is no more than 5%; total cold reduction is at least 15%.

For step 1, apply a uniform 0.03-0.07 mm anti-oxidation coating to both faces of each plate. Stack four to six coated plates, place a steel plate on the top and bottom of the stack, and weld steel bars between the steel plates to form the rolling pack.

Before welding the steel bars, place thermal-insulation wool at the front and rear of the stack along the rolling direction to prevent molten weld metal from entering and contaminating the titanium plates.

After welding the rolling pack, drill two vent holes at each of its front and rear ends along the rolling direction.

Spacing between the two front vent holes is 30-50 mm, and spacing between the two rear vent holes is also 30-50 mm.

The finishing temperature in step 2 is not less than 800 degrees C.

Stress-relief annealing in step 3 is at 750-850 degrees C for 1-2.5 h.

The present invention compared with prior art has the following advantages:

1. The method is simple, easy to operate and readily industrialised.

2. It produces sheet 0.6-2.0 mm thick and 1000-1500 mm wide, filling a product gap, and can also process existing sizes of titanium or titanium-alloy sheet.

3. Combining clad-pack rolling and cold rolling gives a cold-rolled surface, uniform microstructure and good surface quality.

Through embodiment, technical scheme of the present invention is done further detailed description below.

The specific embodiment

Embodiment 1

Step 1. Stack 4 plates of TC4 / Ti-6Al-4V, each 5 mm thick x 1200 mm wide x 1000 mm long, and enclose and weld them into a rolling pack. Coat both faces of every plate uniformly with .05 mm of zirconia, then stack the coated plates. Place a steel plate 20 x 1320 x 1120 mm (thickness x width x length) above and below the stack and weld steel bars between them. Before welding, place thermal-insulation wool at the front and rear along the rolling direction to prevent weld metal contamination. Finally drill two vent holes at each end, with 40 mm spacing between the holes at both ends.

Step 2. Hot-roll the pack on a 2800 mm four-high reversing mill, starting at 950 degrees C, for 12 passes. Per-pass reductions are 10, 17, 18, 22, 17, 17, 15, 12, 7, 7, 2, 4%; total reduction is 80%. Finishing temperature is at least 800 degrees C.

Step 3. Stress-relief anneal the rolled pack at 850 degrees C for 1 h, then shear and open it to obtain sheet 1.0 mm thick.

Step 4. Grind the sheet surfaces to remove scale, then cold-roll on a 1780 mm six-high reversing mill for 30 passes. Per-pass reductions are 5, 4.5, 4.3, 3.8, 3.4, 3.2, 2.8, 1.8, 1.6, 1.5, 1.4, 1.3, 1.2, 1.2, 1.1, 1, 1, 1, 0.9, 0.8, 0.8, 0.8, 0.8, 0.8, 0.8, 0.7, 0.7, 0.7, 0.7, 0.7%; total reduction is 40%. Perform degreasing, heat treatment, pickling, shearing to specified size, microstructure and property testing, finish straightening, sandblasting, washing, flaw detection and water cutting. The final sheet has good surface quality and dimensions .6 x 1200 x 3000 mm (thickness x width x length).

This example combines clad-pack rolling and cold rolling. The sheet has a cold-rolled surface, uniform microstructure and good surface quality.

Embodiment 2

Step 1. Stack 6 plates of TC4 / Ti-6Al-4V, each 10 mm thick x 1500 mm wide x 1000 mm long, and enclose and weld them into a rolling pack. Coat both faces of every plate uniformly with .03 mm of glass-based high-temperature anti-oxidation paint, then stack the coated plates. Place a steel plate 60 x 1640 x 1140 mm (thickness x width x length) above and below the stack and weld steel bars between them. Before welding, place thermal-insulation wool at the front and rear along the rolling direction to prevent weld metal contamination. Finally drill two vent holes at each end, with 50 mm spacing between the holes at both ends.

Step 2. Hot-roll the pack on a 2800 mm four-high reversing mill, starting at 900 degrees C, for 10 passes. Per-pass reductions are 10, 16, 18, 16, 15, 14, 13, 11, 7, 8%; total reduction is 75%. Finishing temperature is at least 800 degrees C.

Step 3. Stress-relief anneal the rolled pack at 750 degrees C for 2.5 h, then shear and open it to obtain sheet 2.5 mm thick.

Step 4. Grind the sheet surfaces to remove scale, then cold-roll on a 1780 mm six-high reversing mill for 15 passes. Per-pass reductions are 4, 4, 2, 2, 1.5, 1.3, 0.9, 0.9, 0.9, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5%; total reduction is 20%. Perform degreasing, heat treatment, pickling, shearing to specified size, microstructure and property testing, finish straightening, sandblasting, washing, flaw detection and water cutting. The final sheet has good surface quality and dimensions 2.0 x 1500 x 3000 mm (thickness x width x length).

This example combines clad-pack rolling and cold rolling. The sheet has a cold-rolled surface, uniform microstructure and good surface quality.

Embodiment 3

Step 1. Stack 5 plates of TC3 / Ti-5Al-4V, each 6 mm thick x 1000 mm wide x 1200 mm long, and enclose and weld them into a rolling pack. Coat both faces of every plate uniformly with .07 mm of zirconia, then stack the coated plates. Place a steel plate 30 x 1130 x 1330 mm (thickness x width x length) above and below the stack and weld steel bars between them. Before welding, place thermal-insulation wool at the front and rear along the rolling direction to prevent weld metal contamination. Finally drill two vent holes at each end, with 30 mm spacing between the holes at both ends.

Step 2. Hot-roll the pack on a 2800 mm four-high reversing mill, starting at 880 degrees C, for 6 passes. Per-pass reductions are 11, 19, 23, 20, 15, 11%; total reduction is 67%. Finishing temperature is at least 800 degrees C.

Step 3. Stress-relief anneal the rolled pack at 800 degrees C for 2 h, then shear and open it to obtain sheet 2.0 mm thick.

Step 4. Grind the sheet surfaces to remove scale, then cold-roll on a 1780 mm six-high reversing mill for 16 passes. Per-pass reductions are 5, 4, 3.4, 2.6, 2.2, 1.9, 1.5, 1.4, 0.8, 0.8, 0.8, 0.6, 0.6, 0.6, 0.6, 0.6%; total reduction is 25%. Perform degreasing, heat treatment, pickling, shearing to specified size, microstructure and property testing, finish straightening, sandblasting, washing, flaw detection and water cutting. The final sheet has good surface quality and dimensions 1.5 x 1000 x 2300 mm (thickness x width x length).

This example combines clad-pack rolling and cold rolling. The sheet has a cold-rolled surface, uniform microstructure and good surface quality.

Embodiment 4

Step 1. Stack 4 plates of TC3 / Ti-5Al-4V, each 7 mm thick x 1400 mm wide x 1000 mm long, and enclose and weld them into a rolling pack. Use the conventional cladding-and-welding method.

Step 2. Hot-roll the pack on a 2800 mm four-high reversing mill, starting at 920 degrees C, for 6 passes. Per-pass reductions are 12, 20, 25, 23, 9, 3%; total reduction is 64%. Finishing temperature is at least 800 degrees C.

Step 3. Stress-relief anneal the rolled pack at 800 degrees C for 2 h, then shear and open it to obtain sheet 2.5 mm thick.

Step 4. Grind the sheet surfaces to remove scale, then cold-roll on a 1780 mm six-high reversing mill for 15 passes. Per-pass reductions are 4, 3, 3, 3, 2, 1.9, 1, 0.9, 0.5, 0.4, 0.4, 0.4, 0.4, 0.4, 0.4%; total reduction is 25%. Perform degreasing, heat treatment, pickling, shearing to specified size, microstructure and property testing, finish straightening, sandblasting, washing, flaw detection and water cutting. The final sheet has good surface quality and dimensions 2.0 x 1360 x 3000 mm (thickness x width x length).

This example combines clad-pack rolling and cold rolling. The sheet has a cold-rolled surface, uniform microstructure and good surface quality.

Embodiment 5

Step 1. Stack 5 plates of TC3 / Ti-5Al-4V, each 5 mm thick x 1200 mm wide x 1000 mm long, and enclose and weld them into a rolling pack. Use the conventional cladding-and-welding method.

Step 2. Hot-roll the pack on a 2800 mm four-high reversing mill, starting at 880 degrees C, for 6 passes. Per-pass reductions are 10, 15, 23, 20, 10, 5%; total reduction is 60%. Finishing temperature is at least 800 degrees C.

Step 3. Stress-relief anneal the rolled pack at 780 degrees C for 1.5 h, then shear and open it to obtain sheet 2.0 mm thick.

Step 4. Grind the sheet surfaces to remove scale, then cold-roll on a 1780 mm six-high reversing mill for 20 passes. Per-pass reductions are 3, 2.5, 1.5, 1.5, 1, 0.8, 0.8, 0.7, 0.7, 0.5, 0.5, 0.5, 0.5, 0.3, 0.3, 0.2, 0.2, 0.2, 0.2, 0.2%; total reduction is 15%. Perform degreasing, heat treatment, pickling, shearing to specified size, microstructure and property testing, finish straightening, sandblasting, washing, flaw detection and water cutting. The final sheet has good surface quality and dimensions 1.7 x 1200 x 2000 mm (thickness x width x length).

This example combines clad-pack rolling and cold rolling. The sheet has a cold-rolled surface, uniform microstructure and good surface quality.

The above; It only is preferred embodiment of the present invention; Be not that the present invention is done any restriction, every according to inventing technical spirit to any simple modification, change and equivalent structure variation that above embodiment did, all still belong in the protection domain of technical scheme of the present invention.

Claims (7)

1. the preparation method of a titanium alloy wide sheet is characterized in that, this method may further comprise the steps:

Step 1. Stack four to six titanium-alloy plates, each 5-10 mm thick and 1000-1500 mm wide, and enclose and weld them into a rolling pack.

Step 2. Use a 2800 mm four-high reversing hot mill to roll the pack for 6-12 passes, starting at 880-950 degrees C, with total reduction not less than 60%.

Step 3. Stress-relief anneal the rolled pack, then shear and open it to obtain titanium-alloy sheet 1.0-2.5 mm thick.

Step 4. Grind the sheet surfaces to remove scale. Cold-roll on a 1780 mm six-high reversing mill for 15-30 passes, then perform finishing operations to obtain sheet 0.6-2.0 mm thick and 1000-1500 mm wide. Cold reduction per pass is no more than 5%; total cold reduction is at least 15%.

2. The method of claim 1, wherein the cladding-and-welding procedure in step 1 is as follows: apply a uniform 0.03-0.07 mm anti-oxidation coating to both faces of each plate. Stack four to six coated plates, place a steel plate on the top and bottom of the stack, and weld steel bars between the steel plates to form the rolling pack.

3. The method of claim 2, wherein: Before welding the steel bars, place thermal-insulation wool at the front and rear of the stack along the rolling direction to prevent molten weld metal from entering and contaminating the titanium plates.

4. The method of claim 2, wherein: After welding the rolling pack, drill two vent holes at each of its front and rear ends along the rolling direction.

5. The method of claim 4, wherein: Spacing between the two front vent holes is 30-50 mm, and spacing between the two rear vent holes is also 30-50 mm.

6. The method of claim 1, wherein: The finishing temperature in step 2 is not less than 800 degrees C.

7. The method of claim 1, wherein: Stress-relief annealing in step 3 is at 750-850 degrees C for 1-2.5 h.

Translation notes

Examples 1-2 use TC4 and Examples 3-5 use TC3; all are retained. Dimensions, percentages and final sizes are reported as printed, including apparent differences between arithmetic reduction and stated finished dimensions. No figures or tables appear in the original publication. This is a patent reference, not a purchase standard.