Claims

1. A 80-mm-thick low-cost FH420 marine engineering steel plate comprising, by weight, C: 0.07%, Si: 0.40%, Mn: 1.60%, P: 0.013%, S: 0.0025%, Nb: 0.030%, V: 0.040%, Ti: 0.020%, Cr: 0.20%, Al: 0.050%, O: 0.0018%, N: 0.0037%, H: 0.00025%, and a balance: Fe and unavoidable impurities.

2. A 80-mm-thick low-cost FH420 marine engineering steel plate comprising, by weight, C: 0.09%, Si: 0.25%, Mn: 1.50%, P: 0.012%, S: 0.0015%, Nb: 0.025%, V: 0.050%, Ti: 0.015%, Cr: 0.18%, Al: 0.040%, O: 0.0011%, N: 0.0038%, H: 0.00017%, and a balance: Fe and unavoidable impurities.

3. A 80-mm-thick low-cost FH420 marine engineering steel plate comprising, by weight, C: 0.10%, Si: 0.30%, Mn: 1.40%, P: 0.011%, S: 0.0030%, Nb: 0.020%, V: 0.035%, Ti: 0.010%, Cr: 0.15%, Al: 0.025%, O: 0.0010%, N: 0.0030%, H: 0.00022%, and a balance: Fe and unavoidable impurities.

4. A 80-mm-thick low-cost FH420 marine engineering steel plate comprising, by weight, C: 0.11%, Si: 0.15%, Mn: 1.30%, P: 0.008%, S: 0.0010%, Nb: 0.010%, V: 0.030%, Ti: 0.005%, Cr: 0.10%, Al: 0.030%, O: 0.0016%, N: 0.0033%, H: 0.00013%, and a balance: Fe and unavoidable impurities.

5. A manufacturing method of the 80-mm-thick low-cost FH420 marine engineering steel plate according to any of the preceding claims 1 to 4, wherein the method comprises following steps:

steelmaking and continuous casting process: desulfurization of molten iron to achieve a target sulfur of 0.004% by weight; a converter smelting adopts dephosphorization by a high-blowing low-drawing method and slag is retained during tapping of the converter; refining adopts white slag operation, a holding time of white slag is 15 min and a total refining time is 35 min; a holding time of vacuum treatment is 20 min; after vacuum treatment, seamless calcium line treatment is carried out; and during continuous casting, a target temperature of a ladle is liquidus temperature +15℃, and a drawing speed is stable;

rolling process: a rolling and cooling control process is adopted and a rolling is carried out at two stages; a heating temperature of a continuously cast blooms before rolling is 1,150℃; a rough

rolling temperature is 980℃, rolling is carried out at high temperature, low speed and large reduction, and a reduction of a first pass is 40 mm; a finish rolling starting temperature is 840℃, and a cumulative reduction rate of a last three passes is 30%; laminar cooling after rolling is carried out, a final cooling temperature is 600℃, and a cooling rate is 5℃/s; and air cooling is carried out afterwards;

heat treatment process: quenching treatment is carried out, a quenching temperature is 890℃, a heating rate is 1.4 min/mm, and a heat preservation time is 0 min; and a tempering treatment is carried out, a tempering temperature is 550℃, a heating rate is 2.0 min/mm, and a heat preservation time is 80 min to obtain the 80-mm-thick low-cost FH420 marine engineering steel plate.

6. A manufacturing method of the 80-mm-thick low-cost FH420 marine engineering steel plate according to any of the preceding claims 1 to 4, wherein the method comprises following steps:

steelmaking and continuous casting process: desulfurization of molten iron to achieve a target sulfur of 0.0035% by weight; a converter smelting adopts dephosphorization by a high-blowing low-drawing method and slag is retained during tapping of the converter; refining adopts white slag operation, a holding time of white slag is 18 min and a total refining time is 40 min; a holding time of vacuum treatment is 21 min; after vacuum treatment, seamless calcium line treatment is carried out; and during continuous casting, a target temperature of a ladle is liquidus temperature +10℃, and a drawing speed is stable;

rolling process: a rolling and cooling control process is adopted and a rolling is carried out at two stages; a heating temperature of a continuously cast blooms before rolling is 1,180℃; a rough rolling temperature is 1,000℃, rolling is carried out at high temperature, low speed and large reduction, and a reduction of a first pass is 38 mm; a finish rolling starting temperature is 850℃, and a cumulative reduction rate of a last three passes is 31%; laminar cooling after rolling is carried out, a final cooling temperature is 620℃, and a cooling rate is 8℃/s; and air cooling is carried out afterwards;

heat treatment process: quenching treatment is carried out, a quenching temperature is 900℃, a heating rate is 1.4 min/mm, and a heat preservation time is 10 min; and tempering treatment is carried out, a tempering temperature is 580℃, a heating rate is 2.0 min/mm, and a heat preservation time is 90 min to obtain the 80-mm-thick low-cost FH420 marine engineering steel plate.

7. A manufacturing method of the 80-mm-thick low-cost FH420 marine engineering steel plate according to any of the preceding claims 1 to 4, wherein the method comprises following steps:

steelmaking and continuous casting process: desulfurization of molten iron to achieve a target sulfur of 0.003% by weight; a converter smelting adopts dephosphorization by a high-blowing low-drawing method and slag is retained during tapping of the converter; refining adopts white slag operation, a holding time of white slag is 19 min and a total refining time is 42 min; a holding time of vacuum treatment is 22 min; after vacuum treatment, seamless calcium line treatment is carried out; and during continuous casting, a target temperature of a ladle is liquidus temperature +8℃, and a drawing speed is stable;

rolling process: a rolling and cooling control process is adopted and a rolling is carried out at two stages; a heating temperature of a continuously cast blooms before rolling is 1,200℃; a rough rolling temperature is 1,050℃, a rolling is carried out at high temperature, low speed and large reduction, and a reduction of a first pass is 35 mm; a finish rolling starting temperature is 860℃, and a cumulative reduction rate of last three passes is 32%; laminar cooling after rolling is carried out, a final cooling temperature is 640℃, and a cooling rate is 7℃/s; and air cooling is carried out afterwards;

heat treatment process: quenching treatment is carried out, a quenching temperature is 905℃, a heating rate is 1.4 min/mm, and a heat preservation time is 15 min; and tempering treatment is carried out, a tempering temperature is 620℃, a heating rate is 2.0 min/mm, and a heat preservation time is 100 min to obtain the 80-mm-thick low-cost FH420 marine engineering steel plate.

8. A manufacturing method of the 80-mm-thick low-cost FH420 marine engineering steel plate according to any of the preceding claims 1 to 4, wherein the method comprises following steps:

steelmaking and continuous casting process: desulfurization of molten iron to achieve a target sulfur of 0.0033% by weight; a converter smelting adopts dephosphorization by a high-blowing low-drawing method and slag is retained during tapping of the converter; refining adopts white slag operation, a holding time of white slag is 20 min and a total refining time is 45 min; a holding time of vacuum treatment is 23 min; after vacuum treatment, seamless calcium line treatment is carried out; and during continuous casting, a target temperature of a ladle is liquidus temperature +5℃, and a drawing speed is stable;

rolling process: a rolling and cooling control process is adopted and a rolling is carried out at two stages; a heating temperature of a continuously cast blooms before rolling is 1,220℃; a rough rolling temperature is 1,080℃, rolling is carried out at high temperature, low speed and large reduction, and a reduction of a first pass is 33mm; a finish rolling starting temperature is 870℃, and a cumulative reduction rate of a last three passes is 33%; laminar cooling after rolling is carried out, a final cooling temperature is 660℃, and a cooling rate is 8℃/s; and air cooling is carried out afterwards;

heat treatment process: quenching treatment is carried out, a quenching temperature is 910℃, a heating rate is 1.4 min/mm, and a heat preservation time is 25 min; and tempering treatment is carried out, a tempering temperature is 650℃, a heating rate is 2.0 min/mm, and a heat preservation time is 120 min to obtain the 80-mm-thick low-cost FH420 marine engineering steel plate.