COMPARISON AND WEAR MATERIAL SELECTION FOR VSI ROS AND HSI IMPACT CRUSHERS

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Summary

VSI ROS (Vertical Shaft Impact "rock-on-steel") and HSI (Horizontal Shaft Impact) crushers are both high-speed impact crushing machines. However, they differ significantly in **energy transfer mechanisms, applicable feed sizes, wear part structures, and material compositions**. The VSI ROS uses a high-speed rotor to throw material against steel anvils, producing cubical-shaped aggregates. In contrast, the HSI uses horizontal rotor blow bars and adjustable impact aprons for primary or secondary crushing. High manganese steel is strictly unsuitable for VSI anvils due to its **low initial hardness, reliance on high-pressure impact to work-harden, and susceptibility to rapid failure and plastic deformation under fine, high-velocity erosion**. High-chromium white iron, ceramic composites, or tungsten carbide inserts offer much higher and more durable surface hardness, greatly reducing wear per ton.

1Comparison: VSI ROS vs HSI

CategoryVSI ROSHSI		
Working Principle	High-speed vertical rotor throws material onto metal anvils ("rock-on-steel" impact)	Blow bars on horizontal rotor throw material to multi-stage impact aprons, achieving a reduction ratio >10:1
Typical Feed Size	⩽75mm	Primary: ⩽1m; Secondary: ⩽200mm
Main Products	0–10mm manufactured sand, shaped aggregates	0–40mm aggregates and recycled materials
Key Wear Parts	Rotor tips, anvils/anvil ring, wear plates	Blow bars, impact aprons, side liners
Wear Material	WC-Co composite tips; Cr26 or Cr26 + ceramic anvils	High-chromium iron, martensitic steel, ceramic composite blow bars

2Why High Manganese Steel Is Unsuitable for VSI Anvils

2.1 Insufficient Initial Hardness

- As-cast manganese steel is only about 187BHN ≈ 10HRC, offering poor wear resistance.

2.2 Requires "High-Pressure Work Hardening" Mechanism

- Hadfield steel must experience impact stress >250MPa to harden its surface up to 550BHN.
- VSI anvils face high-speed fine particle erosion with extremely short contact times, which cannot induce this work hardening.

2.3 Poor Erosion Resistance

Comparative tests show that high-chromium white iron has significantly lower wear rates due to its internal M_7C_3

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- carbides (1050–1500 HV),
- while even hardened manganese steel lacks this level of abrasion resistance.

2.4 Prone to Plastic Deformation and Dimensional Instability

- Under high-speed erosion, manganese steel deforms plastically, disrupting particle trajectories and increasing downtime.

2.5 Economic and Quality Risks

- Due to the complex geometry of anvils, casting with manganese steel often results in high defect rates.
- Short service life and frequent maintenance lead to higher cost per ton.

3Recommended Wear Materials

Component	Recommended Material	Typical Hardness / Features	Application Scenario
Anvil / Anvil Ring	Cr26 High-Chromium Iron	60–64HRC; M_7C_3>1050HV	General to highly abrasive rock
Upgraded Anvil	Cr26 + Ceramic Composite	Surface >70HRC; 1.5–2× longer life	Highly abrasive material (e.g., basalt)
Rotor Tip	WC-Co Tungsten Carbide Bar	90–92HRA; high anti-fracture toughness	Deep cavity VSI, tip speed >70m/s
HSI Blow Bar	Cr26 High-Chromium Iron	60–65HRC, wear-resistant but brittle	Secondary crushing, limestone
HSI Blow Bar	Martensitic Steel Alloy	45–55HRC, high toughness	Construction waste, rebar-containing feed
Upgraded Blow Bar	Ceramic Composite (Cr or Martensitic base)	Extended wear life	Highly abrasive recycled materials

4Operation & Maintenance Guidelines

1. Maintain 35–45mm gap between rotor exit and anvils; replace when worn to geometric limits to avoid feed misalignment.
2. For muddy or high-impact conditions, consider martensitic steel liners in feed zones to absorb shock.
3. Use material zoning: ceramic composite in center, high-chrome on edges — balances cost and life.

Conclusion

VSI anvils require materials that are "instantly hard and remain hard." High manganese steel's reliance on delayed work hardening makes it unsuitable for high-speed erosion environments. Its low initial hardness and deformation issues cause premature failure. Industry practice shows that using high-chromium iron, ceramic composites, or tungsten carbide significantly extends service life, reduces downtime, and lowers wear cost per ton.