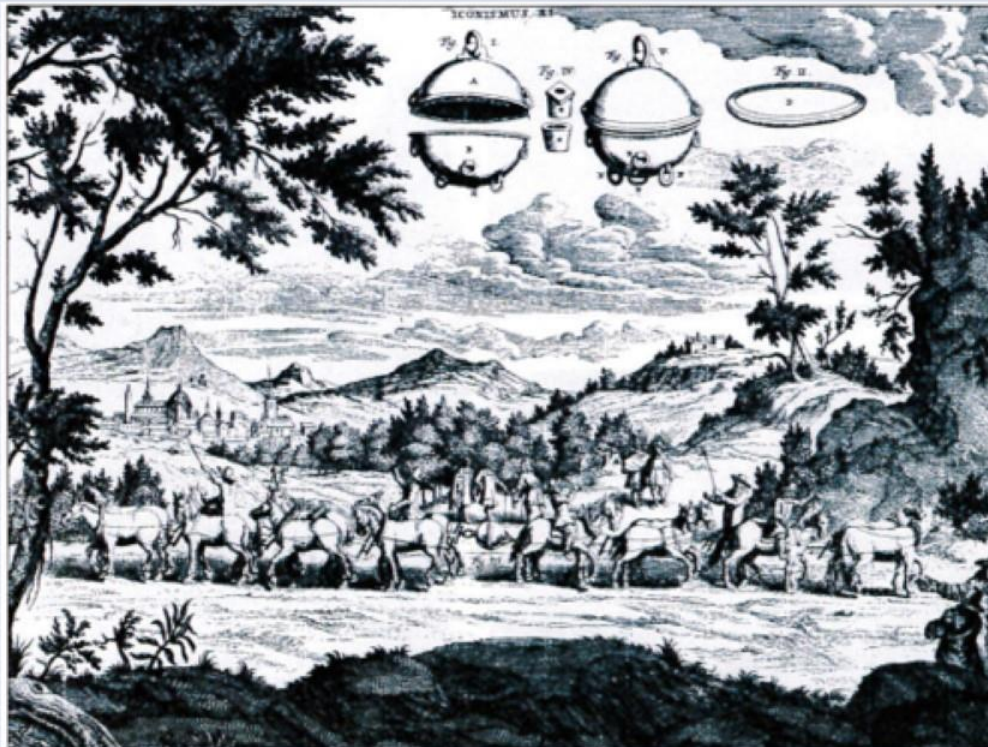




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## Exploration on the Technical Route of Future Development of V -process casting



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## General situation of the 13th five-year plan of casting industry

《"13th Five-Year" National Science and technology development planning》 (Department of development planning, Ministry of science and technology)

《Made in China 2025》 (The first ten years' programme of action for the implementation of the strategy of making powerful countries by the Chinese government) (The State Council)

《Foundry industry development planning "in 13th Five-Year"》 (CHINA FOUNDRY ASSOCIATION)

《The foundry industry and technology development plan "in 13th Five-Year"》

《Casting technology roadmap》 (For 2030)

(Chinese Technological Association of LFC and VPC)



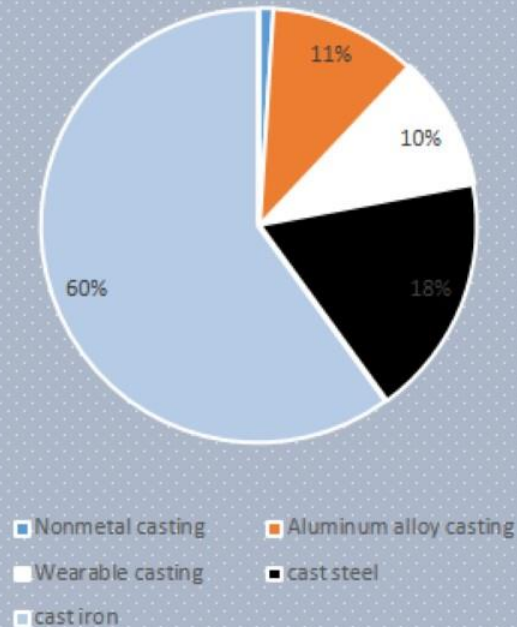
**Explore**

**V-Process Casting technology roadmap for future development**



## *The basic situation of V-process casting in China*

**194 v-process casting foundry**  
**121 cast iron parts production enterprises,**  
**76 counterweight;**  
**37 casting steel casting production enterprises;**  
**20 wear-resistant(high manganese steel,High**  
**chromium cast iron) casting production enterprises;**  
**21 cast alumimum casting production enterprises;**  
**Two non-metal smelting zirconia corundum**  
**manufacturing enterprises;**



Shandong: 35 Jiangsu: 27 Fujian: 21 Hebei: 17 Zhejiang: 13 Hebei: 11 Anhui: 10  
Sichuan: 8 Hubei: 8 Liaoning: 7 Shanxi: 6 Neimenggu: 6 Tianjin: 6 Shanxi: 4  
Hunan: 4 Jiangxi: 3 Beijing: 2 Guangdong: 2 Ningxia: 2 Xinjiang: 2 Chongqing: 2  
Helongjiang: 2 Shanghai: 1 Guangxi: 1 Jilin: 1 Yunnan: 1



*Application field and accommodative material of V-process*

- 1 Engineering machinery: countryweight, Enclosure, Cast steel stents;**
- 2 Railway locomotive: bolster, side frame, coupling, turnout;**
- 3 Petroleum machinery: Enclosure, crank, stand;**
- 4 Auto parts: bridge shell, brake hub;**
- 5 Agricultural machinery: wheel hub, countryweight, flywheel;**
- 6 Mining equipment: tooth plate, hammer head;**
- 7 Iron and steel metallurgy: blanking plate, furnace frame;**
- 8 Municipal: bathtub, manhole, furniture;**
- 9 Other industries: medical apparatus and instruments, power industry, industrial mold;**

***Material:***

***cast iron: gray cast iron; ductile iron; compacted graphite Iron***

***cast steel: carbon steel, alloy steel***

***non-ferrous alloy: aluminum-silicon alloy, copper alloy, zinc alloy***

***non-metallic: zirconium corundum;***





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## *The basic situation of V-process casting in China* *——Some progress of V-process casting*

- *Large-scale mechanized production line has been a breakthrough in the individual products to obtain a good application;*
- *EVA films and V-process special coatings basically meet domestic production needs;*
- *Individual high-class castings are at the forefront of the world;*
- *V-process casting for aluminum alloy, ductile iron manufacturers and the number of product cases are gradually increasing;*







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## *The basic situation of V-process casting in China*

### ——application status and problems

- 1 V-process casting is still used to produce low-class casting; development of cast steel, ductile iron, cast aluminum is relatively limited;
- 2 V-process casting foundry technology still exist fuzzy or blank area, such as the definition of casting defects and design and use of vacuum systems, etc;
- 3 Quantity of firms with a high class characteristics of the relatively small, including problem production capacity, process control, tooling & equipment, production management, etc.,
- 4 Professional production, technology, management personnel is relatively small;
- 5 High class V-process casting equipment to become a domestic bottleneck; auxiliary and patterns basically meet the requirements ;
- 6 The design and construction of V-process casting modernization workshop is insufficient, and its economy and environmental protection have not been well developed.





## Exploration on the Technical Route of V-Process Casting

- **Development route of V- process Casting Technology**
- **Development route of V-casting equipment and production line technology**
- **Development route of V-process casting auxiliary materials technology**
- **Development route of V-process casting patterns technology**
- **Development route of V-process casting products**

## Development route of V-process casting technology

- 1 Deep research on V-process casting (**molding process, vacuum effect**)
- 2 Research on the quality of V-process casting products (**micro-structure and casting defects**)
- 3 Research on the application of V-process casting in multi-domain products (**material, structure, using the characteristics**)
- 4 Composite research of V-process casting and other processes (**molding, core molding, pouring.etc**)



aluminum alloy case



cast iron case



ductile iron case

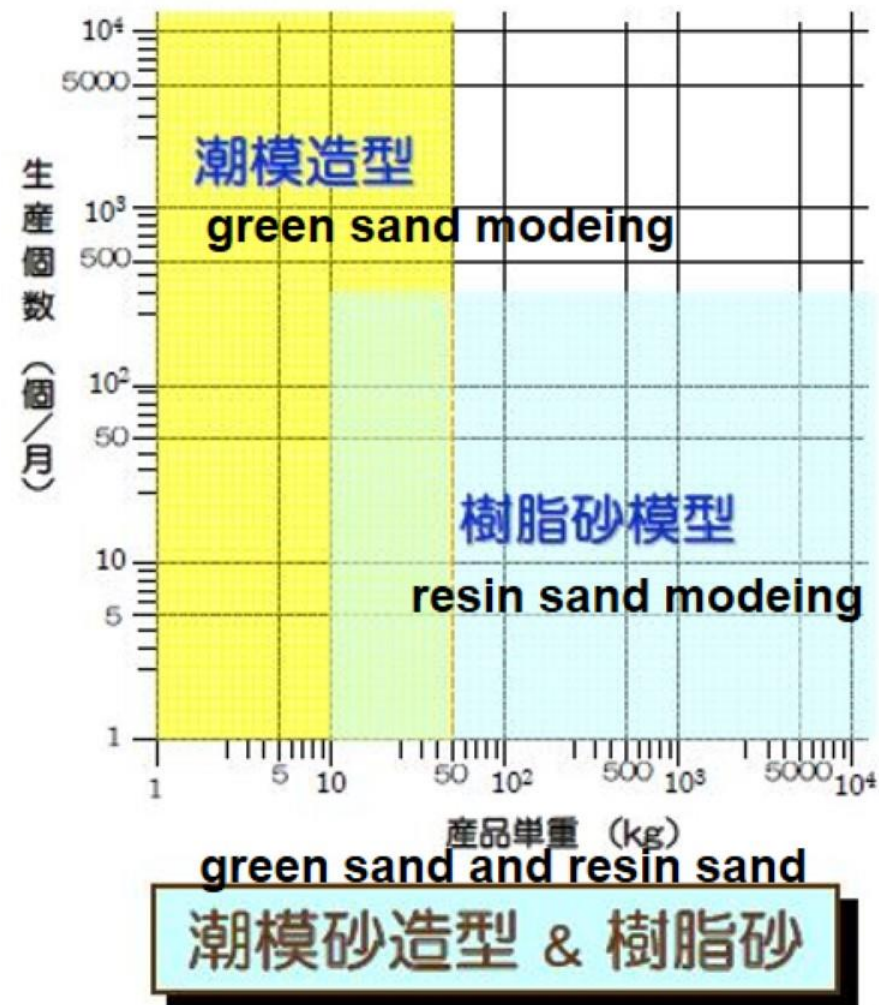
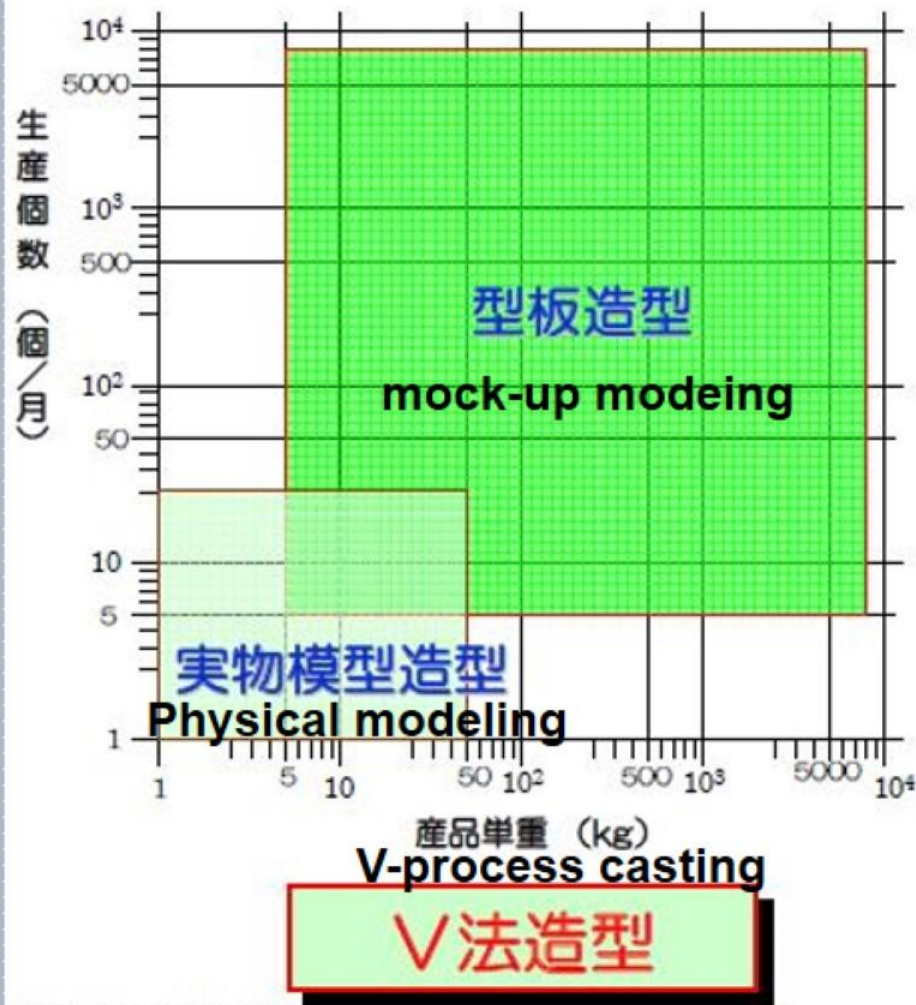




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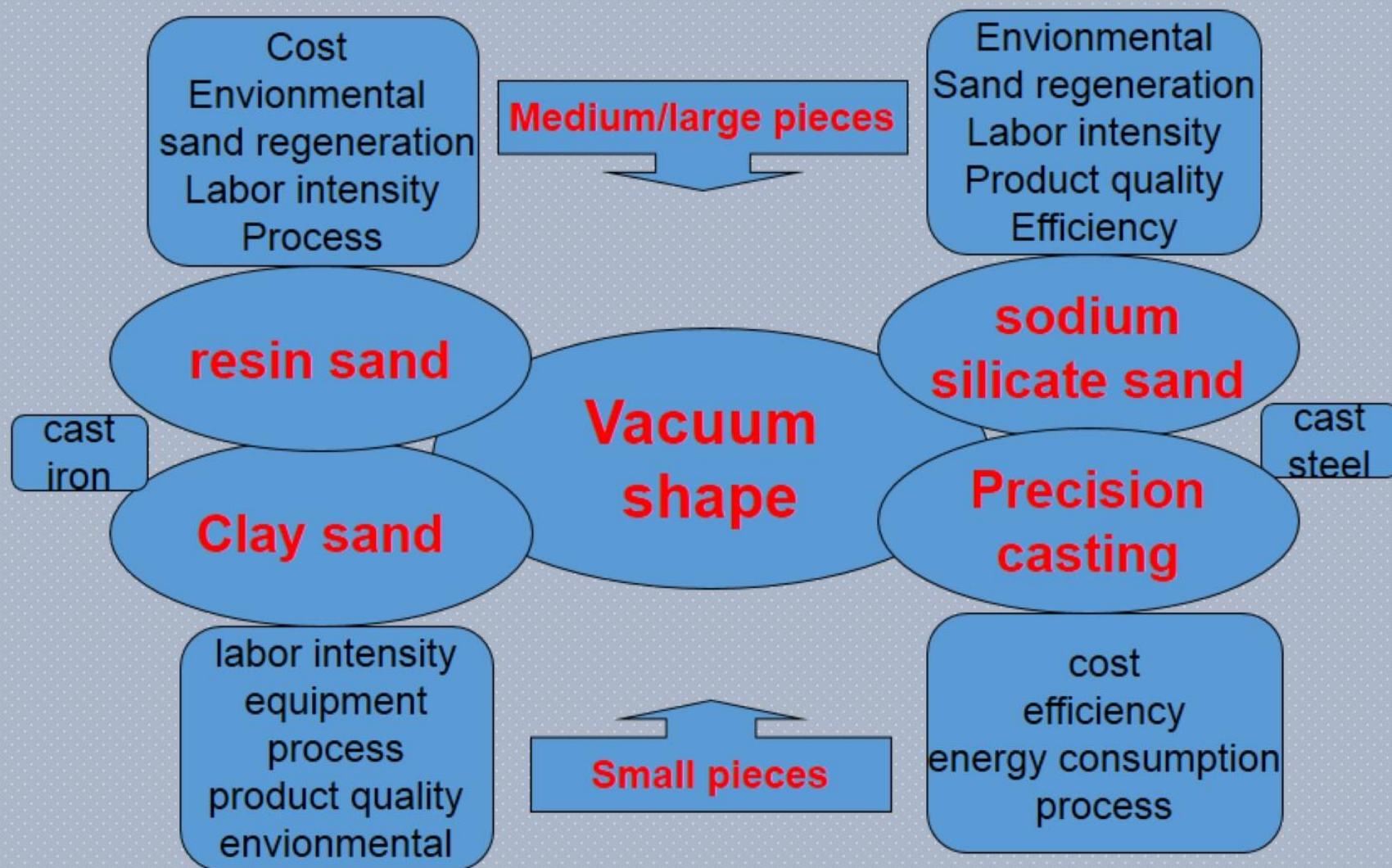
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# Selection of molding process and weight relationship with cast iron products— —process optional overlap and mutual need





## Contrast of V-process casting with other casting processes







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## Technical route for the development of V-casting equipment and production line





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## Experience and analysis of failed V-process casting projects for equipment

Process is difficult to guarantee

Efficiency can not be achieved

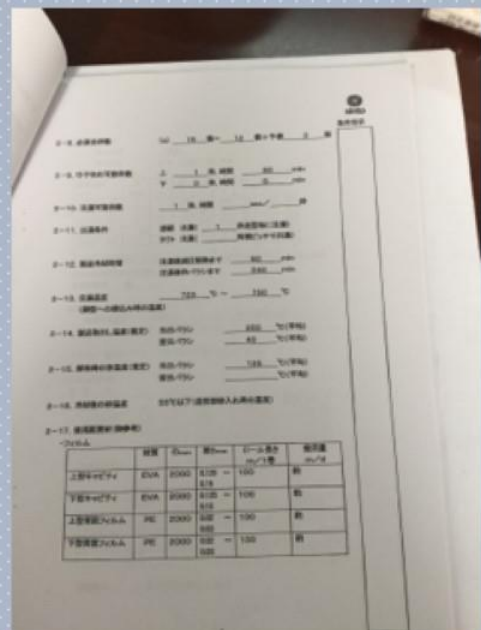
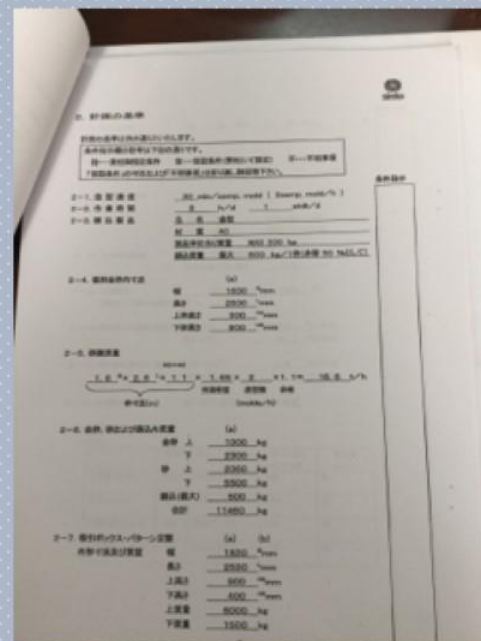
Economy is not good

High labor intensity

low level of environmental protection

process design  
system engineering design  
mechanical technology  
production technology  
environmental awareness

**Casting industry 1.0? 2.0? 3.0? 4.0?**







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## HWS V-process case (1976~2009,57)

Material	Scope of the material	Casting type	Molding efficiency
cast iron	gray cast iron, ductile iron	tub, piano frame, mechanical base, panel	35S/box~30min/box
cast steel	steel, high manganese steel, stainless steel, alloy steel	railway engine casting, valve, windows of the casting	10min/box~50min/box
Colored alloy	aluminium alloy, copper alloy	casting the windows, artwork.etc	4min/box~30min/box

**Mechanization, Automation, Intelligent**

《Videos of V-process casting》

## Development route of V-process casting pattern

### 1 pattern structure:

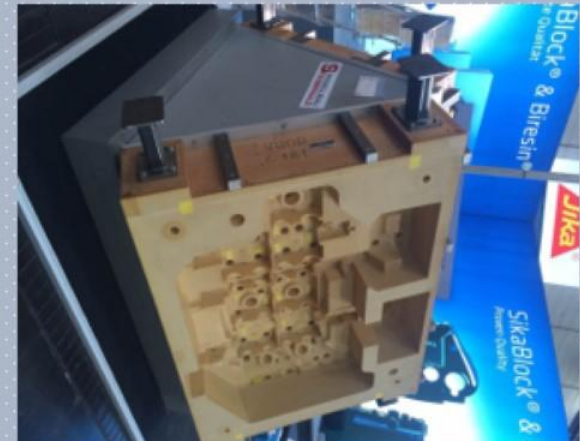
solid molding (Chuzhou jinnuo patent)

Second modling (solve mold problem by process)

### 2 pattern material:

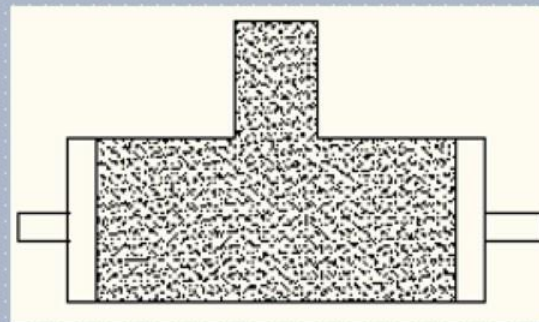
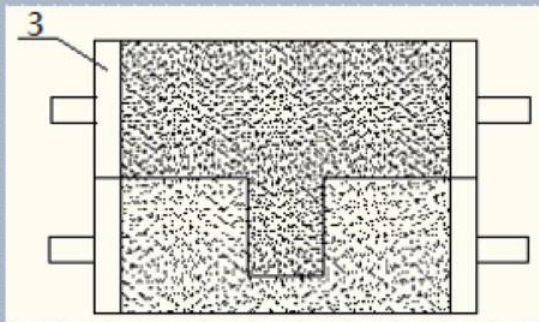
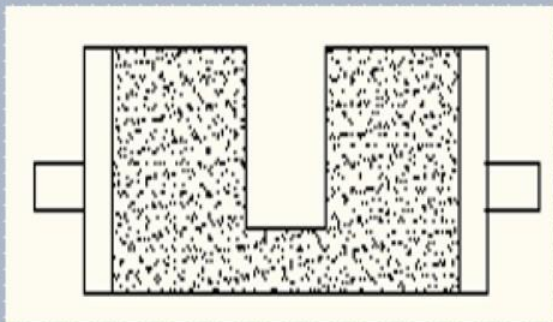
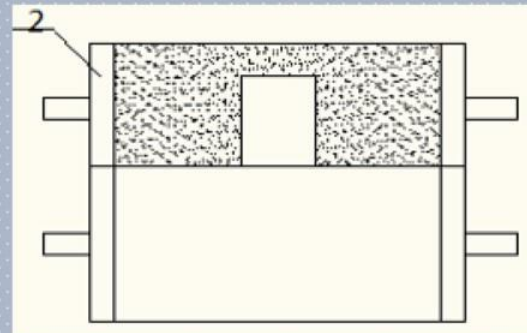
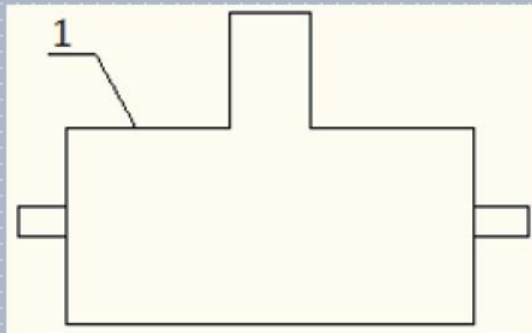
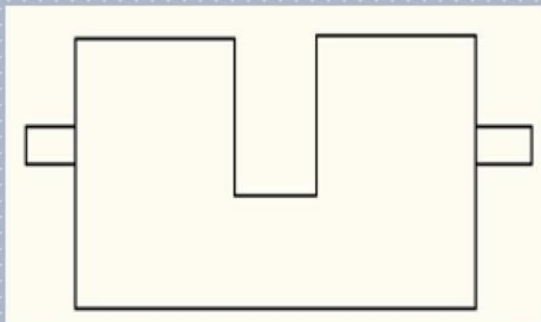
(1) low-cost environmental materials——small batch

(2) good stability material——large scale





➤ Second modeling technique



1, pattern carries, 2, transition flask, 3, flask

➤ Comparison of traditional pattern materials and new materials

Material	Merits and demerits	Cost	Adaptive range
paraffin wax	It is easy to produce sticky knife because of its general processability	30000-40000/m <sup>3</sup>	Small batch
Surface treatment EPS foam	Good processability, resin brushing, grinding trouble	600/m <sup>3</sup>	Small batch
polyurethane	Good processability. Easy to produce dust	2000/m <sup>3</sup>	Small batch
High density board (15mm thickness)	Good processability, easy to produce fluffy debris	450-600/m <sup>3</sup>	Medium batch
Glass fiber reinforced plastic (15mm thickness)	Good processing performance, powder, because of hard texture, cutting tool wear	350-400/m <sup>3</sup>	Large batch
Acrylic board (15mm thickness)	Good processability, but the details of the text easily produce chipping	90-120/m <sup>3</sup>	Large batch
Lumber (pine)	It is easy to produce sticky knife	2600-3000/m <sup>3</sup>	Large batch





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## Development route of V-process casting auxiliary materials

**The five materials——EVA film, coating, sand, riser, chiller**

EVA film: deveopment and use of high-ductile thin film

(product coverage, casting quality influence, cost of production)

Coating: special coatings

(performance, cost, environmental protection)

Sand: reusability, environmental protection, process assurance

Riser: specificity, stability, high efficiency

Chiller: convenience, generalized, flexibility



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## Technical route of V-process casting development

- 1 Material: high quality cast iron, **ductile iron**, alloy cast iron
- 2 basic research: solidification characteristics, microstructure, mechanical properties,
- 3 Hard and difficult technique:
  - (1) Effects of Graphite Morphology on Mechanical Properties of Cast Iron
  - (2) Coordination of Ductile Iron in the Production of Graphite Floating and Shrinkage
  - (3) The importance and particularity of chilling technology in cast iron
  - (4) High carbon cast-iron solidification for special requirements of production equipment







**Gray cast:** *More conducive to the formation of ferrite matrix, more likely to produce A-type graphite; graphite shape is relatively large; low eutectic hot metal V method easier to saturation;*

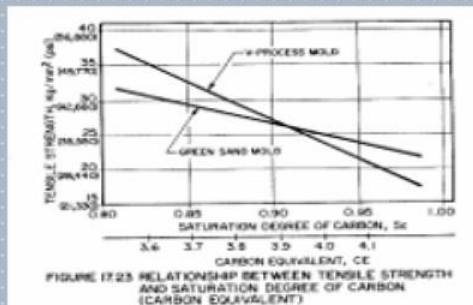
**Ductile iron:** *More conducive to the formation of ferrite matrix, the number of eutectic groups less, larger graphite ball;*



V-process castings type A graphite



Resin sand casting type A graphite



Low carbon yield, the tensile strength of vacuum process product is higher than that of clay sand. High carbon yield;



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# Technology route of cast steel by V-process

Material: midium class carbon steel, high carbon steel, alloy steel

Basic research: solidification characteristis, microstructure, special casting defect.etc.

Hard and difficult technique:

1 Complexity of Cast steel Technology of V-process

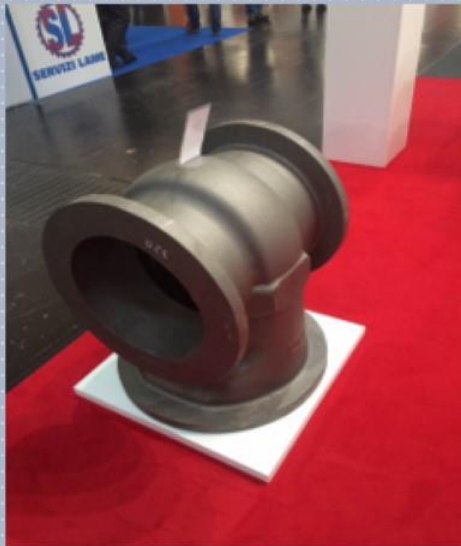
2 Influence of V-process casting on cast steel material (coating, film)

3 V-process characteristics on the follow-up process of steel, such as heat treatment

Casting products:

1 Large cast steel casting, small cast steel;

2 Multi-breed small batch casting;

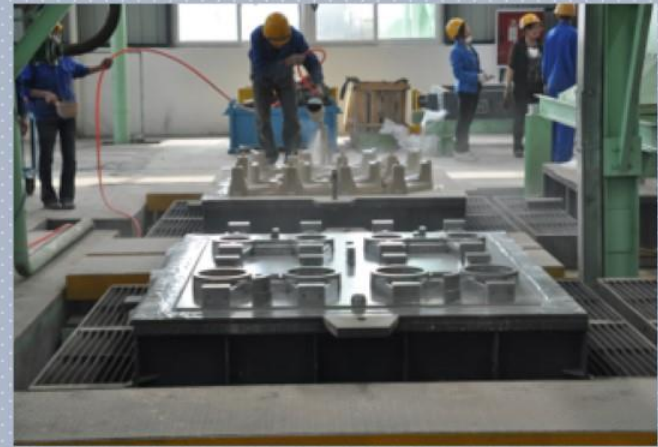




## *Complexity of Cast Steel Process*



*Cope molding*



Spraying



Core setting



Reprocessing procedure



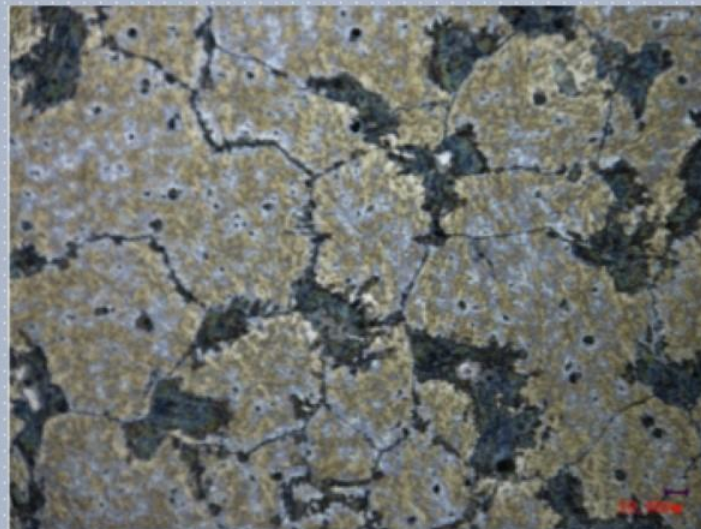
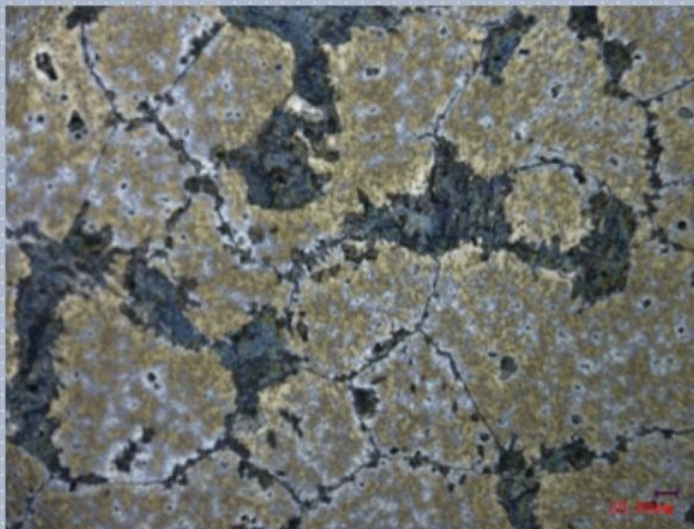


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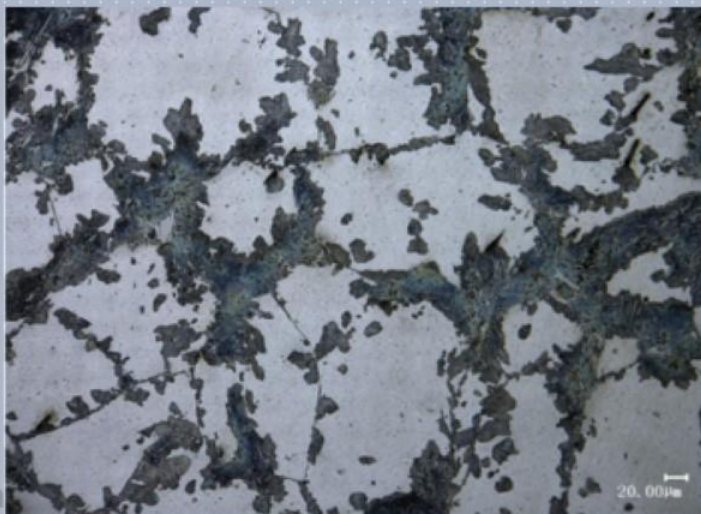
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**Sodium silicate sand (\*500 Times)**

# Case of abnormal organization cast steel



**V-process casting (\*500 Times)**





Material: aluminum and magnesium alloy, copper alloy, zinc alloy.etc

Basic research: solidification characteristics, microstructure, mechanical properties

Hard and difficult technique:

- 1 The influence of V-process casting on the formation of defects
- 2 V-process casting is combined with other casting processes

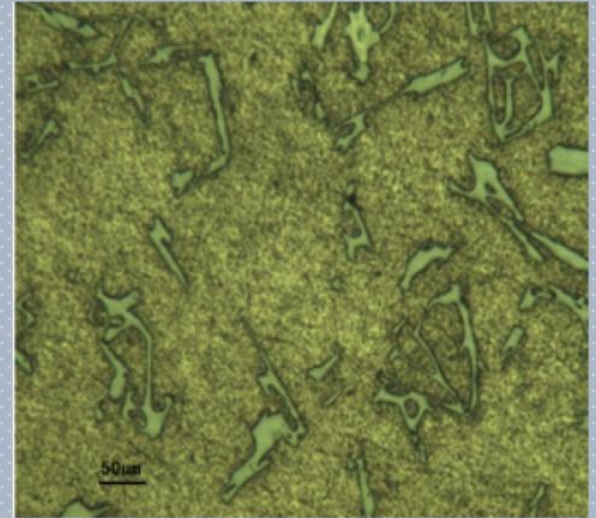
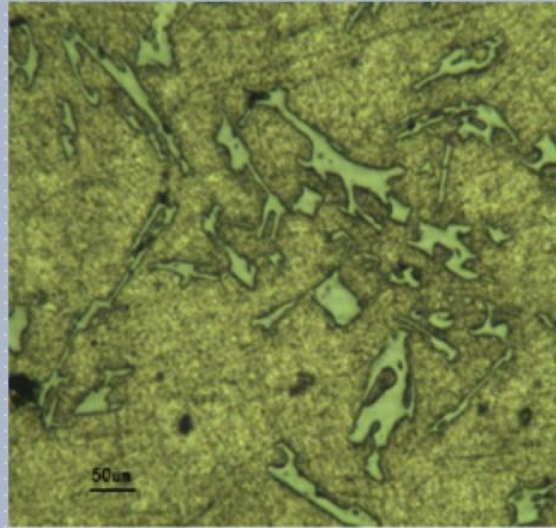
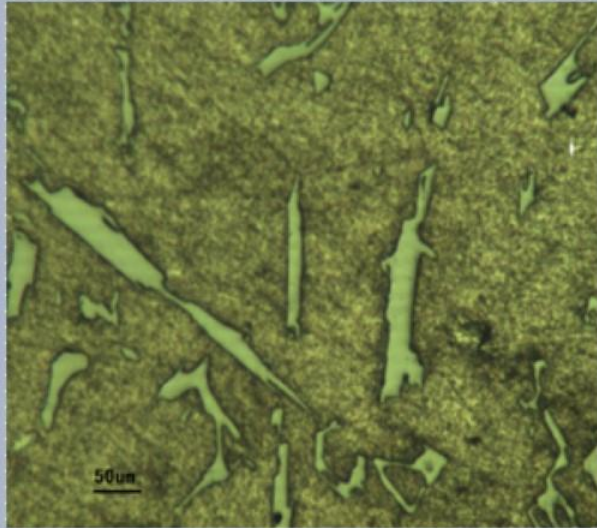
Casting products:

- 1 Large cast aluminum castings of thin-walled
- 2 High precision products





## ➤ Study on Metallographic Microstructure of Aluminum Alloy



Found: Microstructure of white needle for eutectic silicon, larger organizations of the silicon and V-process casting sample diffuses, acicular structure is relatively bulky, length is long, the clay sand and resin sand just the opposite.

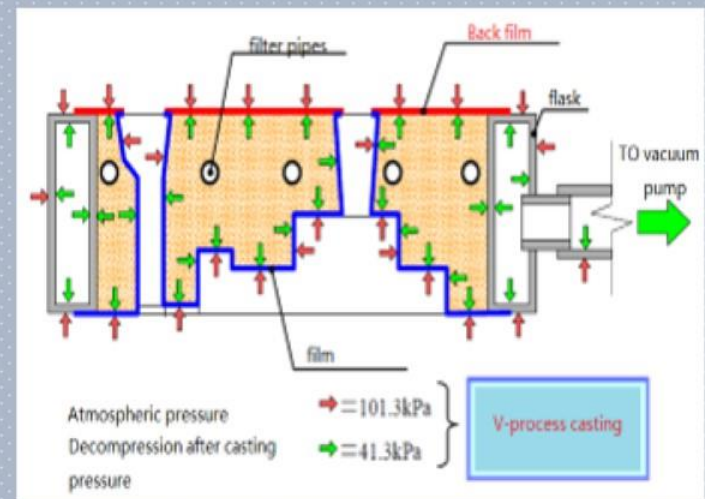
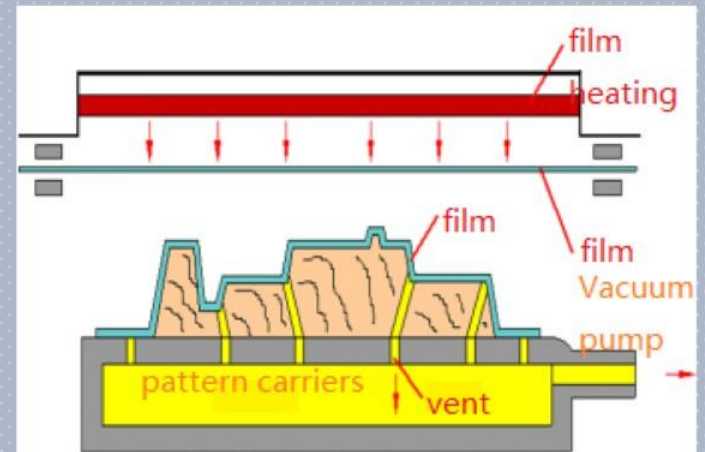




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## Key issues and technical bottlenecks

- 1 Casting defects basis and reliable solutions
- 2 The abnormal structure and the solution of the cooling property
- 3 Efficient and reliable mechanized molding equipment
- 4 Environmental protection, reliable, low consumption of sand processing equipment
- 5 Efficient, stable vacuum system
- 6 High malleable EVA film
- 7 relationship coating characteristics and casting quality





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## Advanced technology for international V-process casting

- 1 Multi-sation rotation/high automation V-process casting production line (HWS,SINTO)
- 2 Cast steel V-process casting technology (Russian valve factory)
- 3 Thin wall complex structure cast alumimum V-process casting (USA HARMONY casting,BOEING)
- 4 The use of high - end resin materials in V - process patterns (Russian factiry)
- 5 Application of ultrathin EVA film on V-process casting (Japanese factories)
- 6 V-process casting produces high quality ductile iron (SINTO)
- 7 Digital management of V-process casting shop (Japanese factories)





## Basic information

1. Modelling : 7 box/hour
2. Percent of pass : 100%
3. Sandbox size : 1600\*1600\*400/900mm
4. Construction area: 8500m<sup>2</sup>  
Workshop: 6750m<sup>2</sup>
5. 45000 Ton/year
6. Single class sculpt personnel : 7
7. Direct employees 52 , Indirect employees 38



## Basic history

- In 2007, the preparation
- In 2008, began production
- In 2009, received IOS14001 certification
- In 2011, received IOS9001 certification





## ME Elecmetal(Minnesota branch of the United States)



The United States of Minnesota company, as the world's leading manufacturer of wear-resistant castings, V-process casting has long been used to produce all kinds of wear-resistant castings, especially the ball mill liner, and achieved good results. At the same time the company's V-process production line for wear-resistant casting of the production process to do a lot of useful improvements in the protection of the smooth implementation of the requirements on the basis of both the protection of the production, but also to achieve a reasonable flow of sand box. The production line design is reasonable, high production efficiency, in the production line design and process with the degree of worthy of the relevant domestic enterprises for reference.





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## Harmony Casting(Located in the United States)

Since 1979, the introduction of V--process casting, has been engaged in aluminum alloy casting production for more than 30 years; its annual output of more than 5,000 tons, the products are mainly used for aerospace, military industry, medical equipment, automation, energy and electricity industries. Over the years, the company has formed a perfect transition from product to service, from the early casting production, to now provide complete sets of products and engineering services; company has a complete CAD / CAE / CAM service process, at the same time with a strong CNC machining Ability, and equipped with component analysis, non - destructive testing, mechanical performance testing, pressure test, heat treatment and a series of advanced means.





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**Thanks for listening**

Chinese Technological Association of LFC and VPC

Wuhan Jianheng Industrial Technology Co.,Ltd



Better Service, Better Industry

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