



Foundry Sand: A Recipe for Beneficial Use

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Outline

- **Profile of the Foundry Industry**
- **Foundry By-Products**
- **Opportunities for Beneficial Use**
- **Conclusions**

Profile of the Foundry Industry

- **2,800 Operating Foundries**
 - 1,000 Ferrous Foundries
 - 1,800 Nonferrous Foundries
- **Employ more than 220,000 people**
- **80% are small operations (less than 100 employees)**
- **\$27 Billion in shipments in 2001**
- **Operating at 76% of capacity**

Source: AFS

Profile of the Foundry Industry

■ What is a metal casting?

- **A casting is a metal part formed by pouring molten metal into a sand mold or metal die. The mold or die is comprised of two halves that, when mated together, form a cavity into which the molten metal is poured. The mold or die form the external surface of the casting. If an internal cavity is required in the casting, a core is placed inside the mold cavity.**

After the metal solidifies, the mold is broken, the cores removed and the part is readied for finishing operations. The sand is then remolded and used again.

Source: AFS

Profile of the Foundry Industry

Ferrous Metals

Cast Iron

Gray Iron

Ductile Iron

Malleable Iron

Compacted Graphite Iron

Cast Steel

Carbon & Low Alloy

Corrosion Resistant

Heat Resistant

Manganese

Non Ferrous Metals

Cast Aluminum

Cast Copper Alloy

Brass

Bronze

Zinc

Magnesium

Titanium

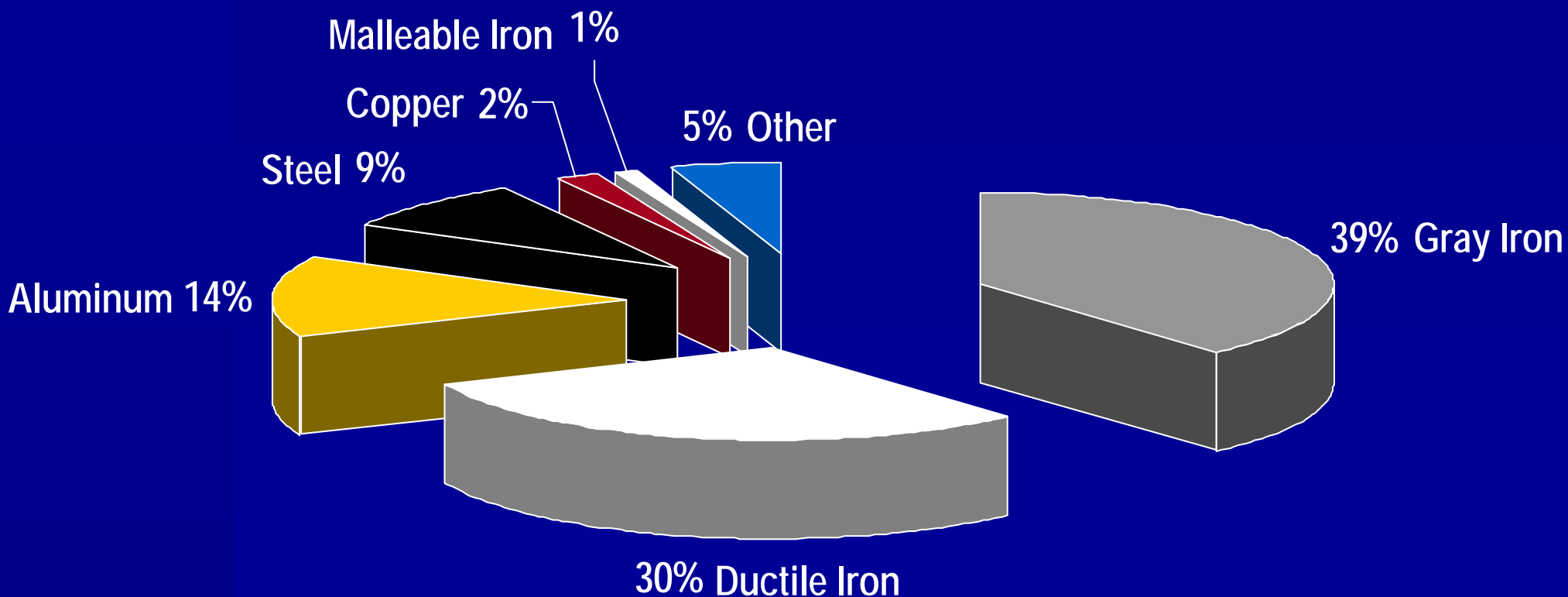
Nickel

Cobalt

Tin

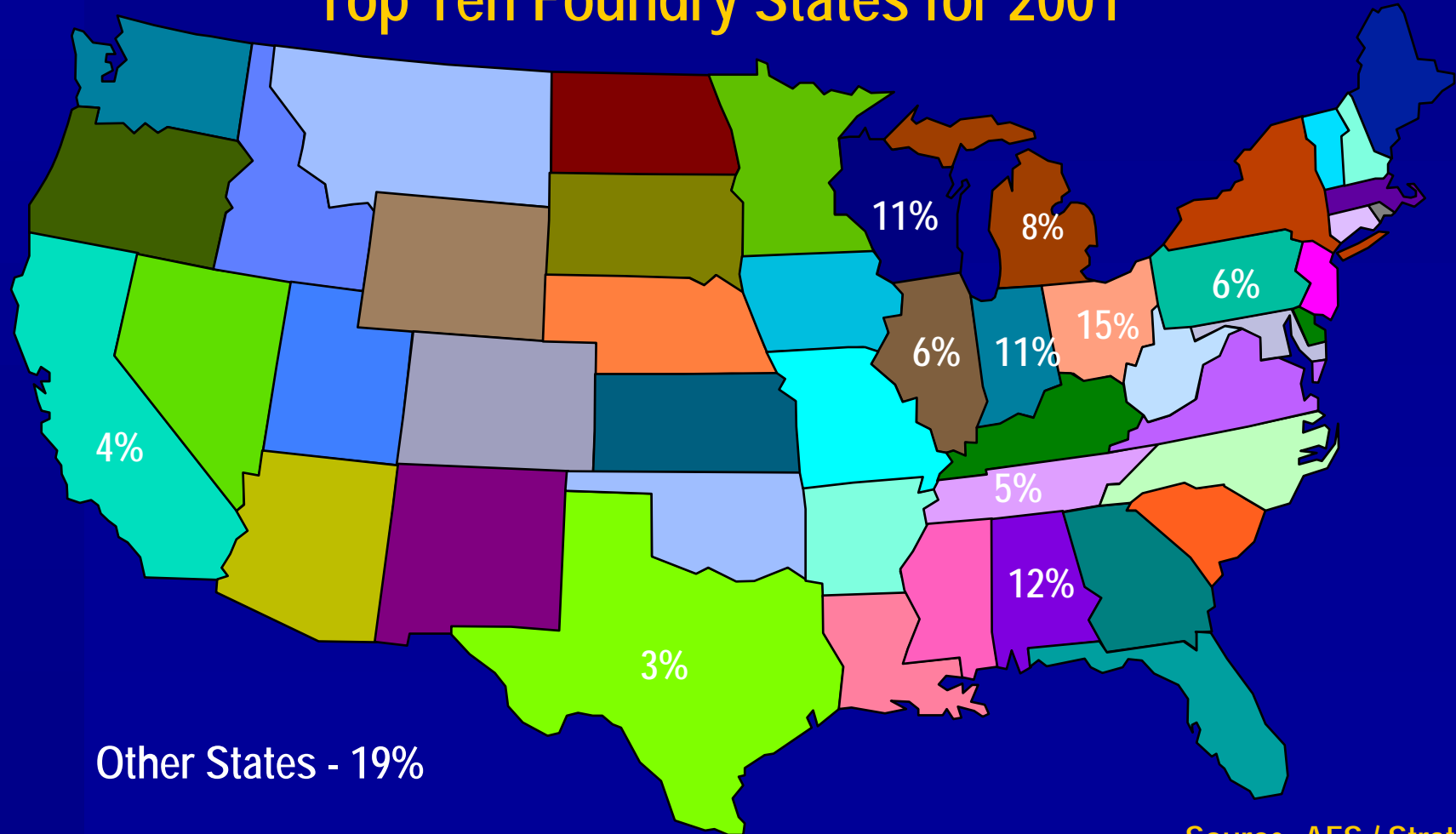
Profile of the Foundry Industry

Casting Shipment Mix for 2001



Profile of the Foundry Industry

Top Ten Foundry States for 2001

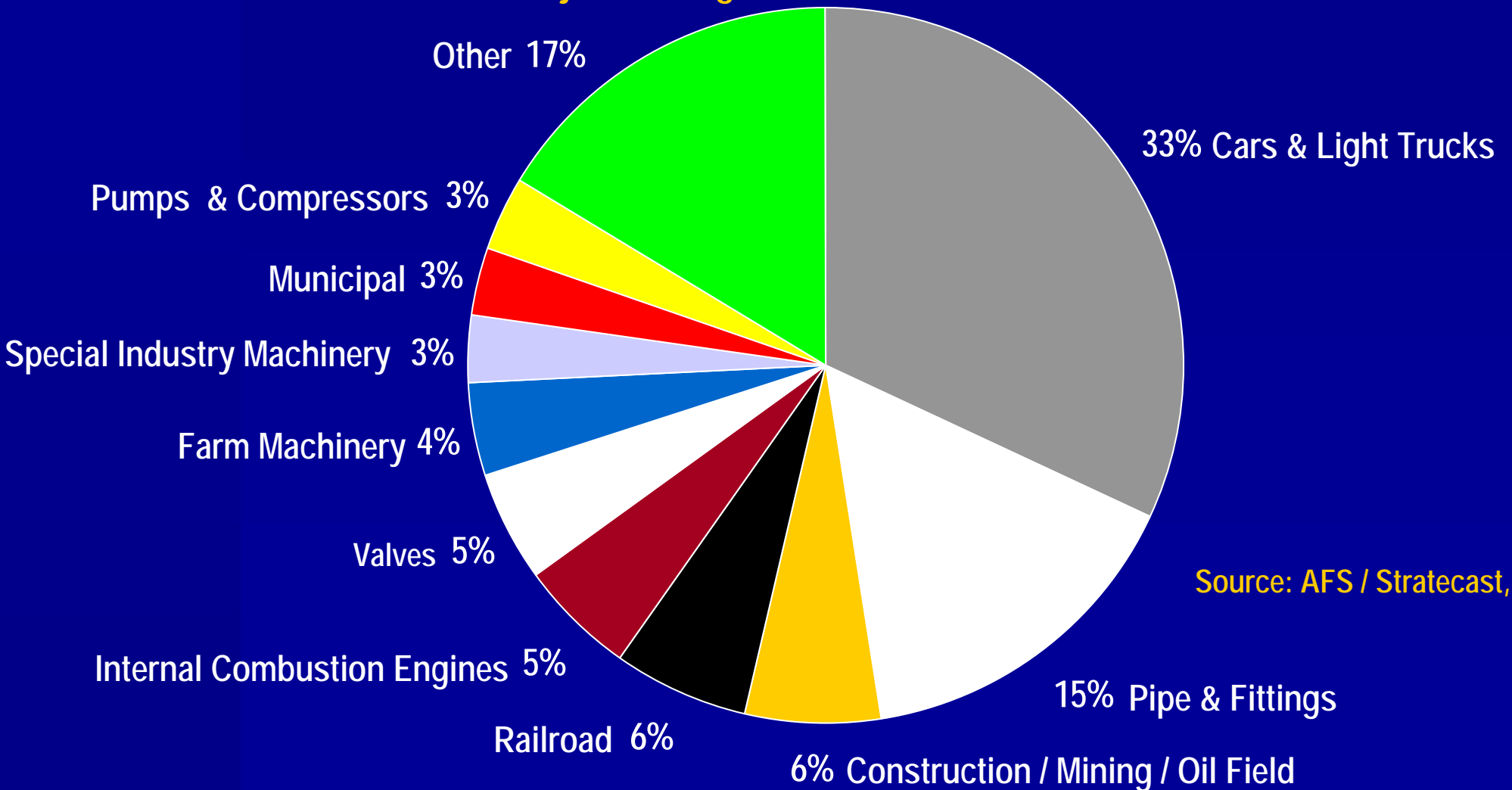


Other States - 19%

Source: AFS / Stratecast, Inc.

Profile of the Foundry Industry

Major Casting End - Use Markets for 2001



Source: AFS / Stratecast, Inc.

Profile of the Foundry Industry

■ 1980's

- **Recession, Increased Regulation, etc.**
- **1,000 foundries close (3,000 plant level)**

■ 1990's

- **Strong Economy, Growth in Automotive Industry**
- **Increase in foundry production**

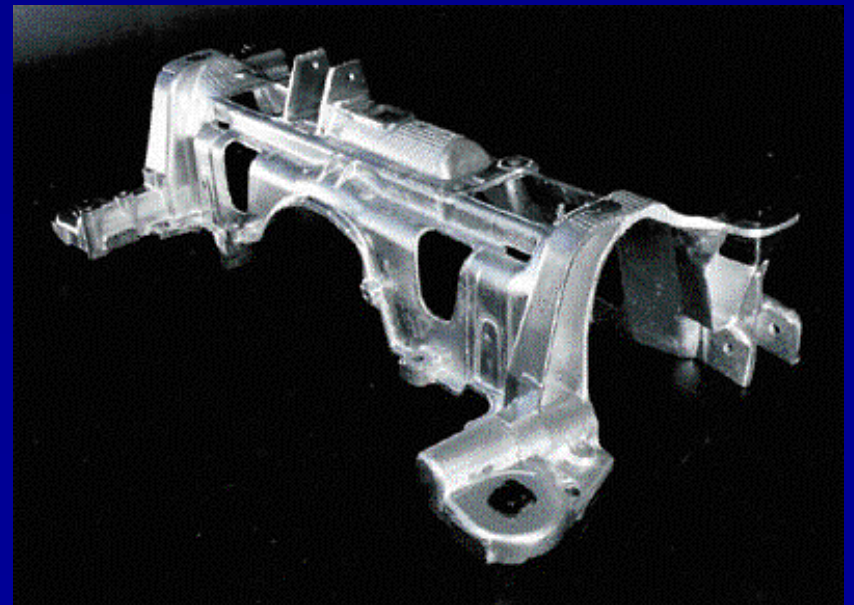
■ 2000's

- **Significant Foreign Competition (China, Brazil, India)**
- **Hardest hit are municipal, malleable iron fittings, diesel engine and machine tool castings**

Source: AFS

Profile of the Foundry Industry

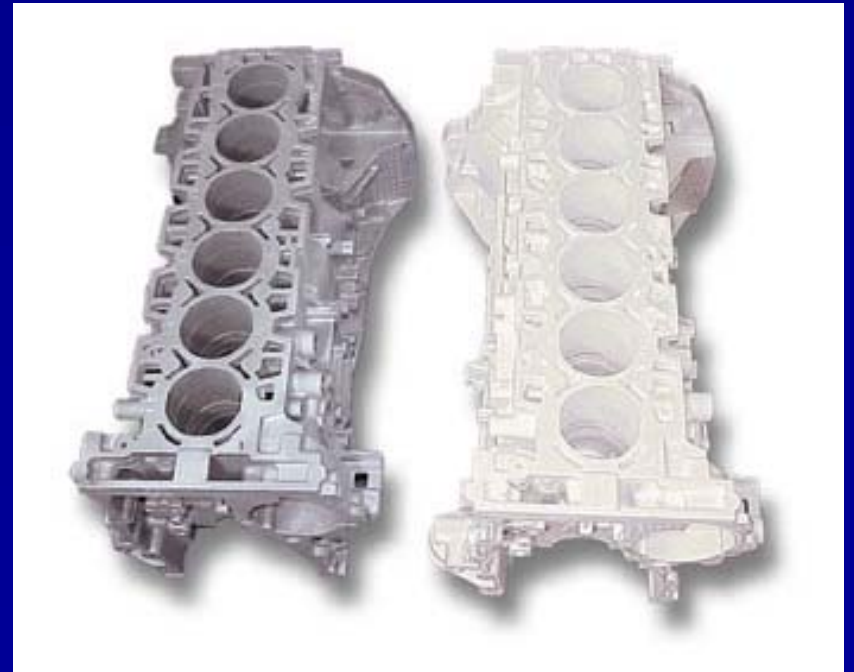
- **Chrysler Minivan Crossmember**
- **Redesign of a steel weldment**
- **Aluminum permanent mold casting**
- **14 lb. Weight savings**
- **Casting adds mounts for ABS, brake junction block assembly, leak detection pump, power steering pump cooler and others**



Source: AFS

Profile of the Foundry Industry

- **Aluminum Cylinder Block for GM's New Vortec 4200 SUV Engine**
- **Cast using the Lost Foam process**
- **Polystyrene pattern is produced and replaced with molten metal to form the casting**



Source: AFS

Profile of the Foundry Industry

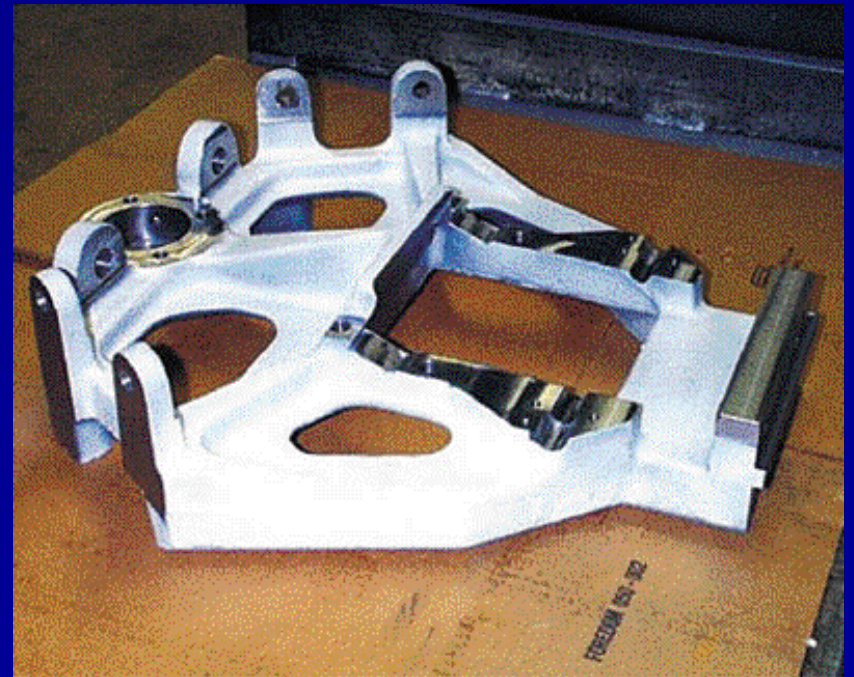
- Ice Cleat for the M1 Abrams Tank
- Steel casting from green sand mold
- Redesigned from a steel forging
- Casting must withstand temperatures to -40° F



Source: AFS

Profile of the Foundry Industry

- **Military Truck Hitch Housing**
- **Redesign of a 35-piece fabricated steel assembly**
- **Steel casting using the green sand molds**
- **Casting reduced components to 10, weighs less, installs faster, is more durable and costs less**



Source: AFS

Profile of the Foundry Industry

- **Air Scoop for Combine**
- **Ductile iron casting (top)
replaced steel weldment
(below)**
- **Casting offered customer
a 40% savings**



Source: AFS

Profile of the Foundry Industry

- **Silicon Bronze Statue is actually an investment casting**
- **Statue weighs 2,000 lbs. and is 12 feet tall**



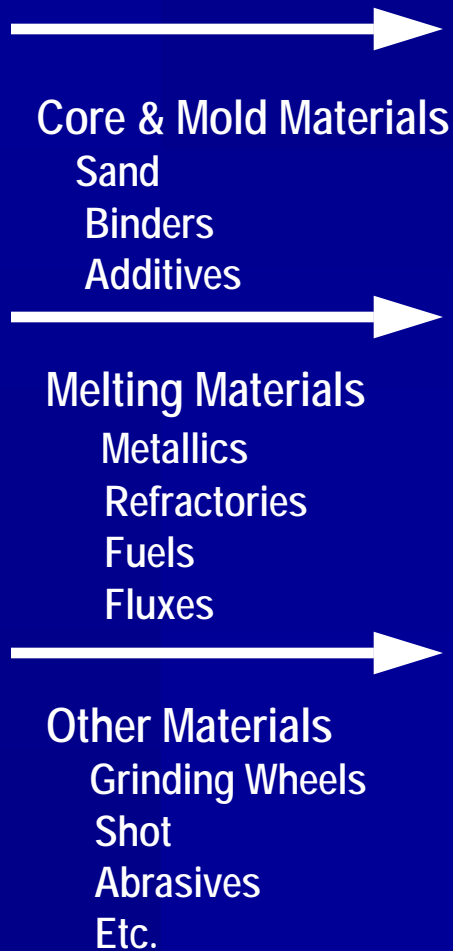
Source: AFS

Green Sand Recipe

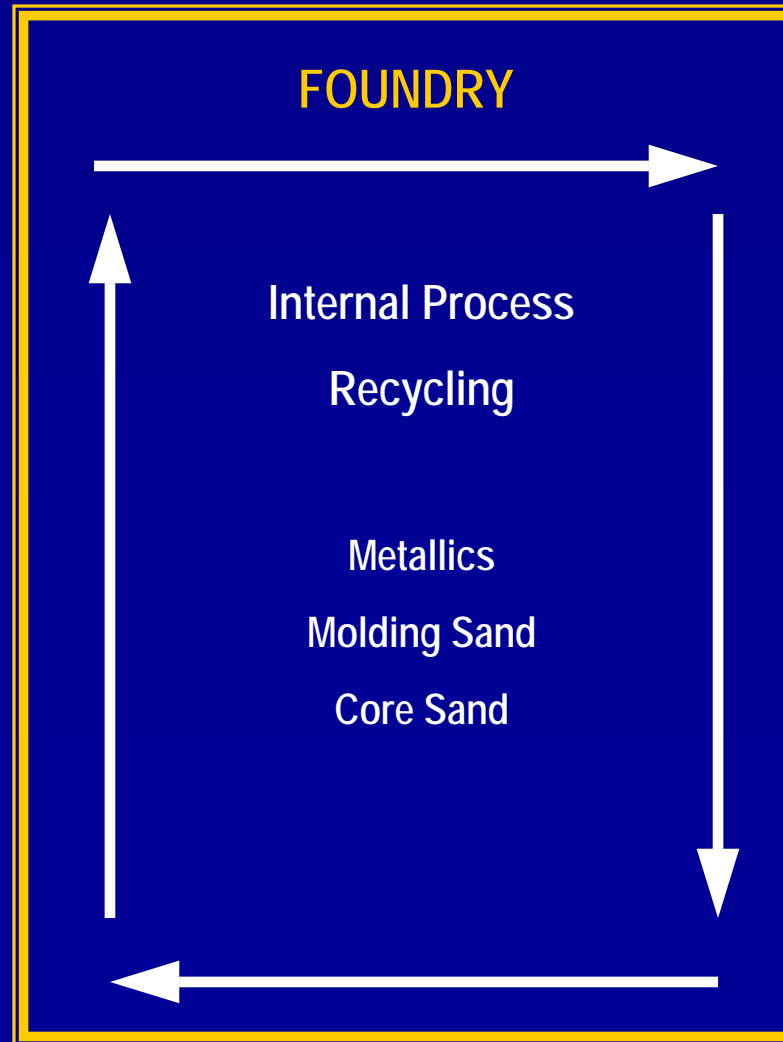
- **80 - 85% Silica Sand**
- **8 - 10% Bentonite Clay**
- **3.5 - 6% Sea Coal (ground bituminous coal)**
- **3 - 4% Water**
- **Other Minor Components**
- **Mix ingredients well in a muller**
- **Transport mix to mold making area**

Foundry By-Products

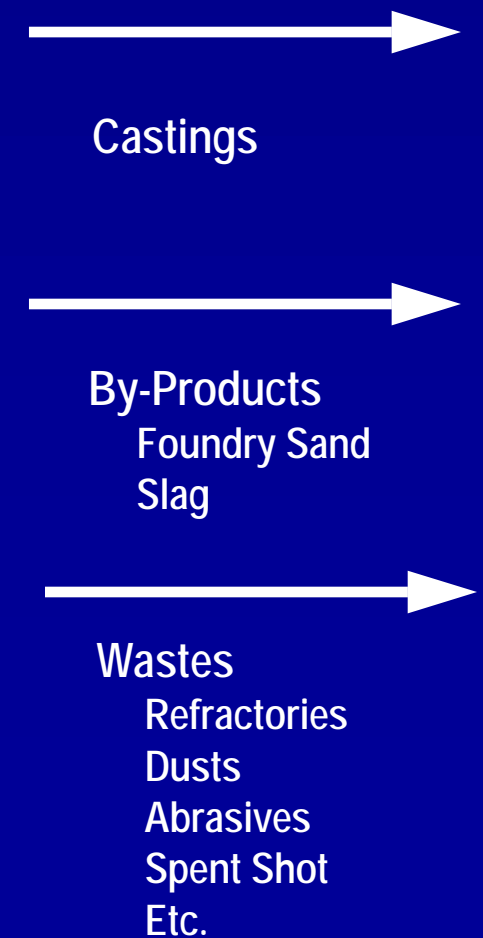
INPUTS



FOUNDRY



OUTPUTS



Opportunities for Beneficial Use

- **The Metalcasting process requires large volumes of sand for molding.**
- **Metalcasters use and reuse about 100 million tons of sand annually.**
- **Approximately 6 million tons (6%) can no longer be reused in the foundry process and is available for beneficial use.**

Opportunities for Beneficial Use

- **Construction - Engineered Fill / Road Subbase**
- **Flowable Fill (CLSM)**
- **Fine aggregate for asphalt pavement**
- **Cement Manufacturing**
- **Precast Concrete Products**
- **Potting and Specialty Soils**
- **Bricks and Pavers**
- **Landfill Daily Cover**

Construction - Engineered Fill



Flowable Fill (CLSM)



Asphalt



Precast Concrete Products



Potting and Specialty Soils



"Name Brand" Potting Soil vs. FS

Parameter	Potting Soil	Chemically Bonded Sand	Green Sand	Mixed Sand
Arsenic	15.3	<0.05	<1.9	<0.2
Barium	137	<0.04	11	1.93
Cadmium	1	<0.1	<0.42	<0.34
Chromium	33.3	<0.004	<19.6	<2
Lead	16.3	0.28	<2.6	<3.41
Mercury	0.16	<0.02	<0.1	<0.1
Selenium	3.3	<0.05	<0.3	<0.35
Iron	22,400	0.4	1,467	NA

Conclusions

- **The foundry industry is an important component of US manufacturing and a significant recycler**
- **Foreign competition poses a significant threat to the viability of this industry**
- **6 Million tons of foundry sand available for beneficial use annually**
- **Effective beneficial use of foundry sand:**
 - **environmentally safe**
 - **conserves natural resources**
 - **contributes to industry sustainability**

Barriers to Beneficial Use

- **Wide variability between different state programs on beneficial use**
- **Limited self-implementation regulatory programs**
- **Smaller foundries cannot always afford to conduct required testing**
- **Typical end uses require large volumes of material**
- **Stigma associated with classification as a solid waste can be hard to overcome**

Sources of Information

■ Sources of additional information:

American Foundry Society - www.afsinc.org

Ductile Iron Society - www.ductile.org

FIRST - www.foundryrecycle.org

Investment Casting Institute - www.investmentcasting.org

Non-Ferrous Founders' Society - www.nfs.org

North American Die Casting Assoc. - www.diecasting.org

Steel Founders' Society of America - www.sfsa.org