Federal University of Technology, Minna

METAL CASTING TECHNOLOGY IN NIGERIA – PRESENT STATUS AND FUTURE PROSPECTS

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Professor of Mechanical Engineering

Inaugural Lecture Series 8

29TH SEPTEMBER, 2005

FEDERAL UNIVERSITY OF TECHNOLOGY,
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METAL CASTING TECHNOLOGY IN NIGERIA PRESENT STATUS AND FUTURE PROSPECTS

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Preamble

I feel honoured and privileged to deliver the 8th Inaugural Lecture of the Federal University of Technology, Minna and the second in the series from the School of Engineering and Engineering Technology. The lecture is titled "Metal Casting Technology in Nigeria Present Status and Future Prospects".

Metal casting is one of the oldest and most important manufacturing technologies. Without manufacturing, there would be little need for engineers and technologists or, indeed, for many of the people who are engaged in supporting activities. Manufacturing is a central function of most technically educated people. The ultimate purpose of all engineering activity is to produce something tangible and salable, hopefully for the benefit of humanity. It is the lifeline of all industrialized society. Without it, few nations could afford many of the amenities that improve the quality of life for their citizen.

Metal casting is vital to the economy and security of a nation. In addition to transportation, aerospace, and defence, cast metal products are found in virtually every sector of economy including energy exploration and conversion, mining, construction, maritime, fluid power, instrumentation, computers and myriads of household products. Cast metal components include: engine blocks; suspension parts for railcars, trucks and autos; fluid flow and power components including valves, pumps, faucets, pipes and fittings; mining and oil field, and energy producing equipment; surgical equipment and prosthetic devices; and components for many of the household and electronic devices we all use everyday. The future holds great promise for the metal casting industry. But to remain competitive and maintain a viable domestic industry, challenges must be overcome in industry recognition, casting design, processing efficiency, and employment attractiveness.

1.0 INTRODUCTION:

Casting is one of the earliest metal shaping methods known to mankind. It generally means pouring molten metal into a mould with a cavity of the shape to be produced, and allowing it to solidify. When solidified, the metal object is taken out from the mould either by breaking the mould or taking the mould (die) apart. The solidified object after removal of gates and risers is called casting. Casting or founding process is extensively used for the manufactures of products/components for almost all industries such as agriculture, construction, cement, chemical, petro-chemical, air-craft, ship-building, machine tool industries, etc. And hence, foundry industry is rightly said to be the mother of all industries, as it feeds all industries with the components produced as castings.

The strength of the foundry industry rests on the fundamental nature of casting as a process for causing metals to take shapes that will serve the needs of man. Certain advantages are inherent in the metal casting process:

The most intricate of shapes, both external and internal may be cast.

It is possible to cast practically any material whether ferrous or non-ferrous.

Extremely large, heavy metal objects may be cast when they would be difficult or economically impossible to produce otherwise. Large pump housings, valves and hydroelectric power plant parts weighing up to 200 tones are examples.

There are certain metals and alloys which can only be processed by casting due to their metallurgical nature. The highly useful and low cost cast irons, which exceed the total of all other metals in tonnage cast, illustrate this fact.

Castings generally cool uniformly from all sides and they have no directional properties.

Highly adaptable for mass production

Necessary tools required for moulds are simple and relatively inexpensive. As a result, trial production or production of a small lot, it is an ideal method.

Construction may be simplified. Products may be cast in a single piece which would otherwise require production in several pieces and subsequent assembly if made by other methods.

A decided economic advantage may exist as a result of any one or a combination of above mentioned points.

It is also true that conditions may be such that the casting process must give way to other methods of production. For example, machining produces smooth surfaces and dimensional accuracy not obtainable by other processes; forging aids in developing the ultimate of fibred strength and toughness in steel; welding provides a conventional method of joining or fabricating wrought or cast products into complex structures; and stamping produces lightweight sheet metal parts.

Metal castings have been practiced in the middle belt of Nigeria over 2000 years ago through iron melting during the Nok-culture. Iron smelting was also known to be in practice in Kano City

over 1000 years ago. Bronze castings were made on the South-Western plains of Benin, Ife and Egboukwu for over 1000 years (Inuwa, 1995).

Although, Nigeria has lots of the metal casting industry, it has remained underdeveloped. The present status of the metal casting technology vis-à-vis the industry has been discussed and the future prospects have been outlined.

2.0 HISTORY OF METAL CASTING

2.1 Metal Casting Through the Ages in the World:-

A casting is the essential foundation of civilization. With it, man unlocked his future, placing him on the path toward conquering his environment. History tells us this started in Mesopotamia, today's modern Iraq. The oldest casting in existence today is believed to be a frog, cast in Copper in 3200 B.C. The frog's complexity indicates that it was preceded by other simpler castings. According to biblical records metal casting technology reached back almost 5500 years B.C. Gold, pure in nature, most likely caught prehistoric man's fancy as he probably hammered gold ornaments out of the gold nuggets he found. Silver would have been treated similarly. Copper was found next as it appeared in the ash of his camp fires from Copper bearing ore that he lived his fire pits with. Man soon found that Copper was harder than gold or silver. Alloys that could be easily melted followed and hence came the use of bronze and brass, not only for cooking pots and utensils, but also to make tools and implements such as axes and arrow heads.

The use of iron was relatively unknown except in areas where iron bearing minerals were abundant. Steel followed much later.

Since its discovery, metal casting has played a vital role in the development and advancement of human cultures and civilization.

After more than 5000 years of technological advances, metal casting plays a greater part in our everyday lives and is more essential than it has every been. A brief timeline of metal casting history is presented below:-

3200 B.C.	-	A Copper frog is cast in Mesopotamia.
2000 B.C	-	Iron is discovered
645 B.C	-	Earliest known sand molding (Chinese)
500 A.D	-	Cast crucible steel is first produced in India, but the process was lost until 1750, when Benjamin Huntsman reinvents it in England..
1455	-	Cast Iron pipe to transport water (Germany)
1794	-	First use of Cupola in Iron founding. (England)
1809	-	Development of Centrifugal Casting. (England)
1815	-	Introduction of Cupola in US foundry.
1826	-	Production of Malleable Iron (USA)
1837	-	First dependable molding machine (USA)
1845	-	Development of Open Hearth Furnace
1863	-	Development of Metallographic (England)
1870	-	Sandblasting is first used to clean large castings. (USA)
1896	-	American Foundrymen's Association (now called American Foundry Society) is formed.
1897	-	Investment casting is rediscovered to cast dental inlays (USA)
1906	-	Use of first electric arc furnace

1913	-	First true stainless steel melted (England)
1923	-	Formation of the International Committee of Foundry Technical Associations in Zurich, Switzerland
1930	-	First use of spectrographic for metal analysis (USA)
1947	-	Invention of Shell Process (Germany)
1948	-	Development of Ductile Iron (SG Iron)
1953	-	Development of Hot Box Process for Core making.
1958	-	Full mould process development
1965	-	Invention of Scanning Electron Micro-Scope (England)
1965	-	Development of Cast Metal Matrix Composites.
1968	-	Introduction of Cold Box Process for coremaking.
1970s	-	Development of Semi-Solid Metalworking Process
1971	-	V- Process Development (Japan)
1972	-	First Austempered Ductile Iron (ADI) Component production.
1974	-	In mould process for ductile iron treatment.
1976	-	Compacted Graphite Iron (CGI) development
1982	-	Introduction of Warm box binder system
1993	-	First foundry application of a plasma ladle refiner.