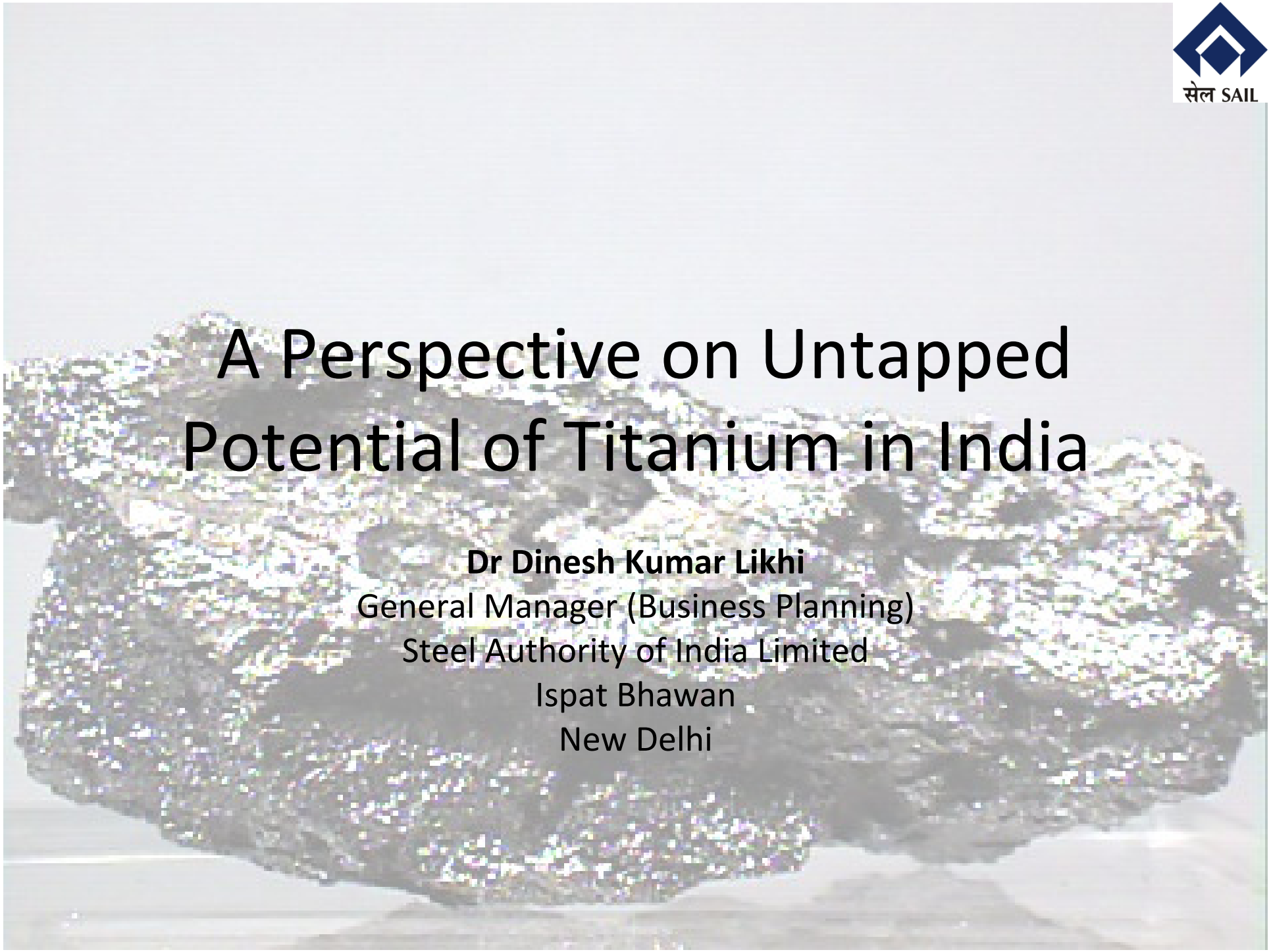

A Perspective on Untapped Potential of Titanium in India

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Agenda

- Introduction
- Production of Titanium from its ore
- Four keys to a Nation’s competitive advantage
- Untapped potential in India
- Major concerns
- Conclusion

Introduction

- Titanium is also known as "Space Age Metal" - application in space, defense, and aeronautics technology
- Fourth most abundant metal in earth's crust
- Always bonded to other elements in nature
- Properties
  - Excellent corrosion resistance, high strength and low density
  - Strong and lightweight
    - As strong as steel, but weighing only 56% as much as steel - highest strength-to-weight ratio
    - Quite ductile, lustrous and metallic white in color
- 95% of Titanium ore extracted is refined into Titanium dioxide (TiO2)

Introduction

- Applications
  - Most of the uses of titanium revolve around titanium alloys - aerospace, military, industrial process, automotives, medical instruments, and other applications.
  - TiO2 - white permanent pigment used in paints, paper, toothpaste, plastics, inks, paper

- Occurrence
  - Estimated Global reserve base of Titanium ore is 2000 M Tonnes
  - Mineral deposits are dispersed worldwide - sites in Australia, United States, Canada, South Africa, India and several other countries
  - Main ores of Titanium - Ilmenite (91-96% TiO2), Rutile (45 - 65% TiO2), Brookite, Titanite and Perovskite

Production of Titanium from its Ore

Ore Mining and Beneficiation

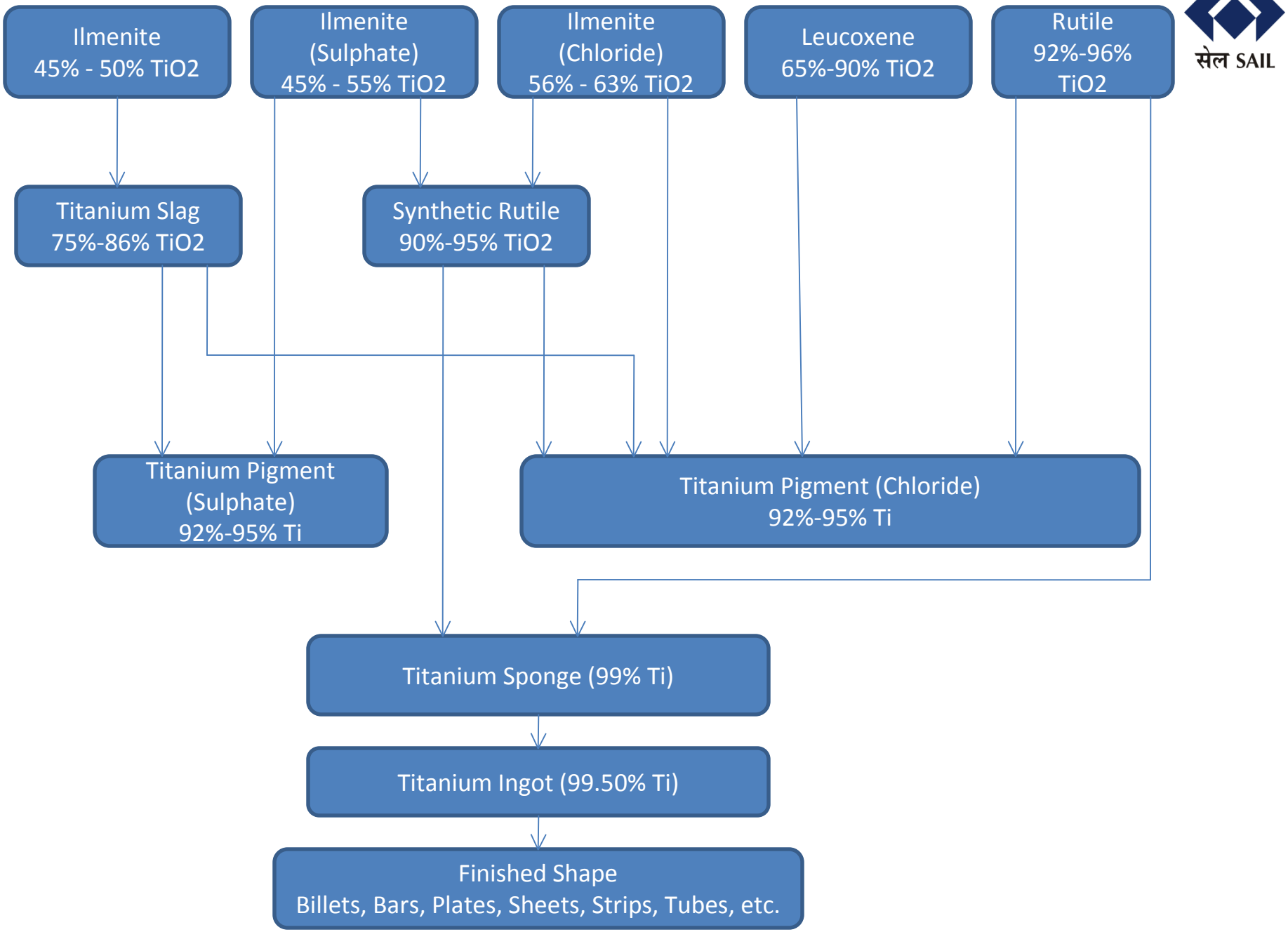
- Ilmenite ($FeTiO_3$) / Rutile (TiO_2) / pigments
- Ilmenite upgraded to either synthetic or converted to Titanium slag

Extraction of Titanium Ore

- Reduction of Titanium ore into Sponge
- Melting of Sponge to form an Ingot

Fabrication of ingots / forging / working

- Ingot is converted into general mill products
- Finished shapes from mill products


Ilmenite
45% - 50% TiO2
Ilmenite
(Sulphate)
45% - 55% TiO2
Ilmenite
(Chloride)
56% - 63% TiO2
Leucoxene
65%-90% TiO2
Rutile
92%-96%
TiO2
Titanium Slag
75%-86% TiO2
Synthetic Rutile
90%-95% TiO2
Titanium Pigment
(Sulphate)
92%-95% Ti
Titanium Pigment (Chloride)
92%-95% Ti
Titanium Sponge (99% Ti)
Titanium Ingot (99.50% Ti)
Finished Shape
Billets, Bars, Plates, Sheets, Strips, Tubes, etc.

Four keys to a Nation's competitive advantage

- Professor Michael E. Porter 's four keys to a Nation's competitive advantage
  - Demand conditions
  - Related and Supporting industries
  - Factor (input) conditions
  - Company strategy & rivalry

- Titanium not being produced commercially in India at present

Untapped Potential in India

- Excellent reserves of Titanium minerals like Ilmenite and Rutile
- Titanium bearing ilmenite deposits are estimated at around 375 – 400 Mt i.e. 21% of global deposits approx.
- Installed capacity only 1% approx. of the total world's capacity
- Demand of around 150,000 t/yr of Titanium dioxide – Imports about 70% of it
- Per capita consumption of Titanium products in India is 0.4 kg - Per capita consumption in developed countries is 5 kg
- Titanium dioxide (TiO2) is a global industry worth USD 11 billion
- Global demand growth for TiO2 is estimated to average 2.7%/year in the 10 years to 2019
- Demand of TiO2 is expected to increase rapidly in India - adoption of new technologies in every field
- High growth rate of TiO2 consuming industries – Coating 10-12%, Plastics 11-14%, Printing inks 14-16%

Major Concerns

- Lack of National policy on Titanium
- Non availability of appropriate technology
  - Closely held by a few developed countries (Australia, South Africa, USA, Russia, Japan)
- Environmental concerns and Land availability
  - Titanium minerals located in the coastal regions of south India
  - Significant reserve in Tamil Nadu is in forest area
  - Andhra Pradesh and Orissa - concerns about marine life extinction
  - Production of one tone of synthetic rutile results in an equal amount of iron oxide, disposal of which is cumbersome
  - One tone of sulphate pigment results in about 13-14 tonnes of effluent and disposal of which is also very cumbersome
  - Most of the land is inhabited by local people
- Capital intensive industry

Conclusion

- Application of Titanium to be increased exponentially - with growing economy, advancement of new technologies and increasing development in the future
- Current market for Titanium in India is devoid of any major player
- Indian companies with experience and skills in related industries should venture
- Large investment, R&D, government support, know-how, project management skills would be extremely essential
- Collaboration with foreign partners with know-how, technology and experience
- Different players may come up with complementary strengths

सेल SAIL

Thank You!