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Peculiarities of Gas Dynamic Spray Applications in Russia.

A. Shkodkin, A. Kashirin, O. Klyuev, T.Buzdygar

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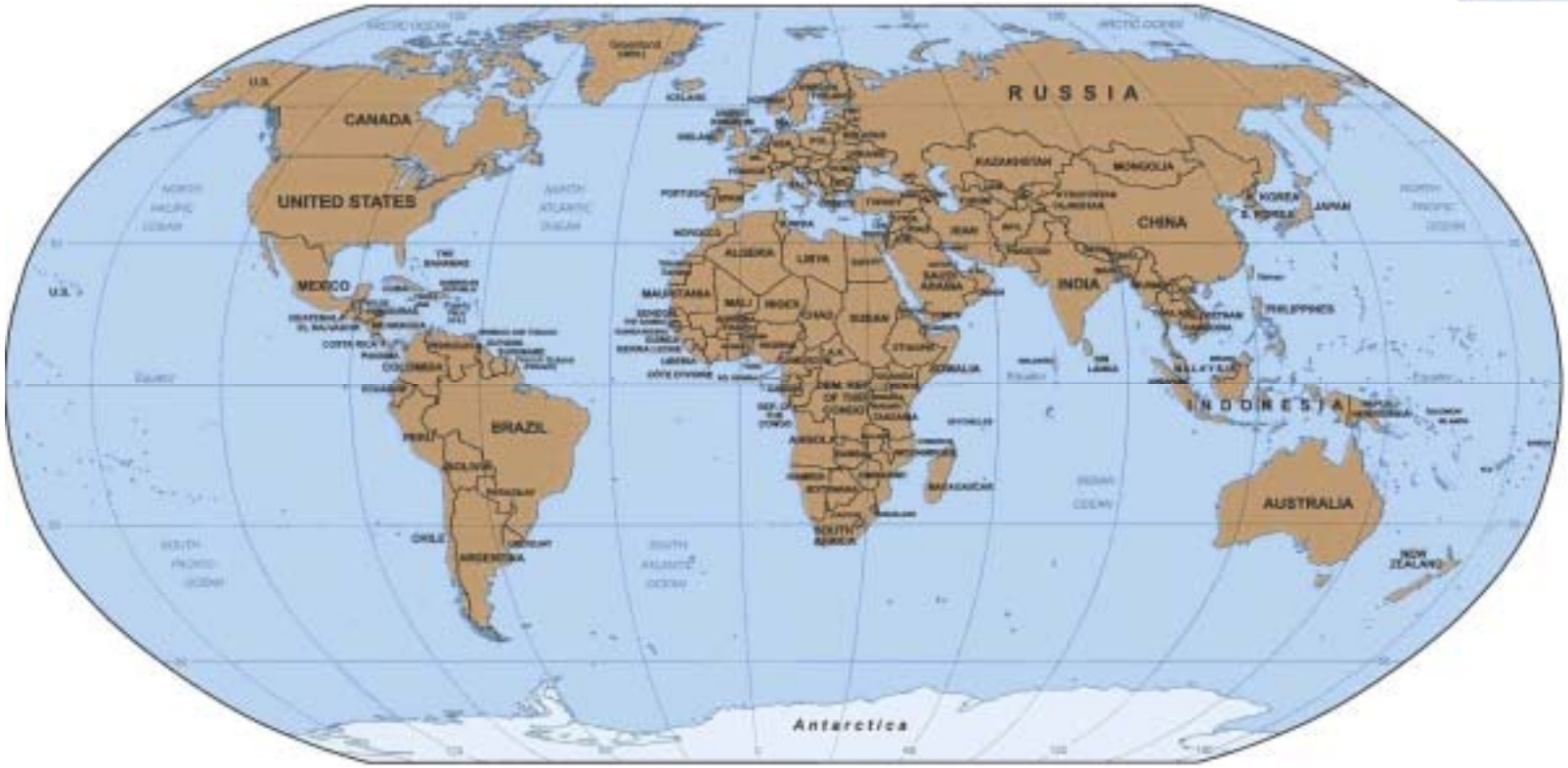

- Huge distances and long frosty snow winter – transport charges and delays
- Many old plants and factories with old worn equipment – parts renewal or restoration
- Unique facilities and products of complex technology

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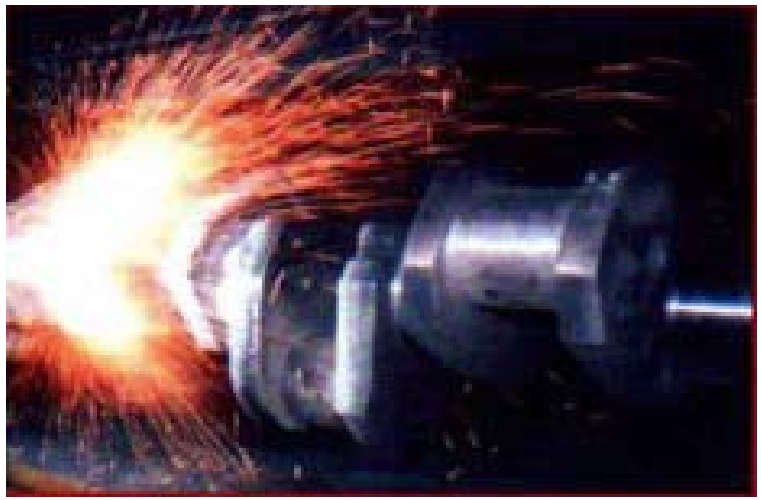
Conventional methods of metal deposition

- Vacuum sputtering
- Welding deposition
- Hot galvanizing
- Thermal spraying

  - thermal stresses
  - thermal deformation



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The main advantage of Gas Dynamic Spray or Cold Spray：

- metal deposition with low heat input
- dense uniform deposit of any thickness
- local deposition to limited area
- deposition to any metal surface

DYMET

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High Pressure Systems

- ITAM (Novosibirsk)
- IntermetComposite (Moscow)

- Customer problems ……
- - limited and expensive helium
- - limited high pressure nitrogen supply
- - tight restrictions to high pressure equipment

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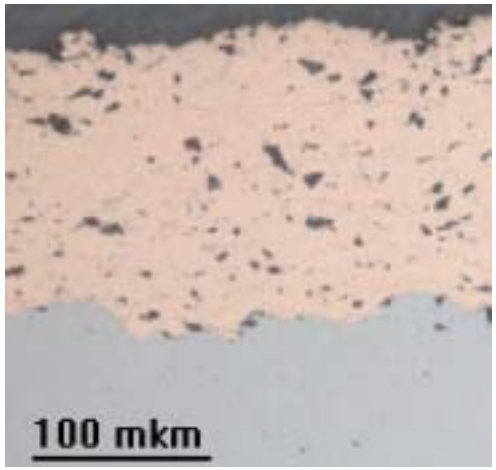
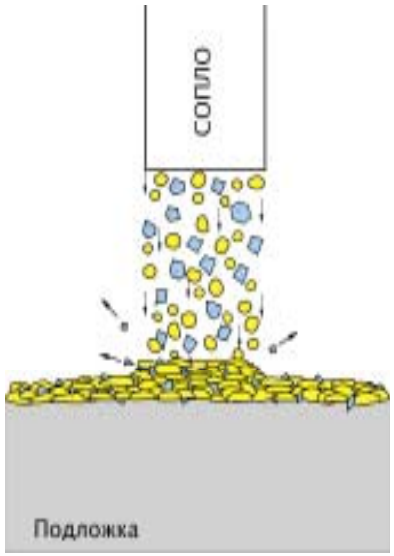
Potential customer has
- 6 bars air net or 8 – 10 bars air compressor

- DYMET technology was developed to use air to deposit at velocities below critical value

- metal and ceramic powder mixture jet to modify deposit surface for the further deposition
- high quality coatings
- decrease of deposition efficiency



A. Shkodkin, A. Kashirin, O. Klyuev, T. Buzdygar.
The basic principles of DYMET technology.
ITSC 2006, Seattle, USA



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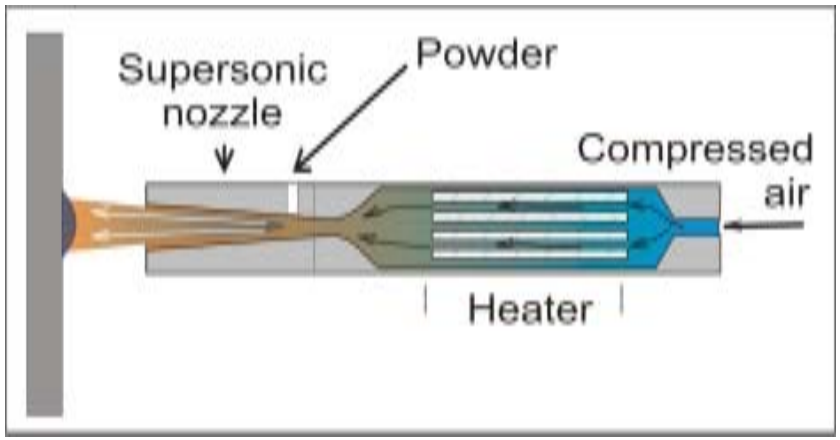
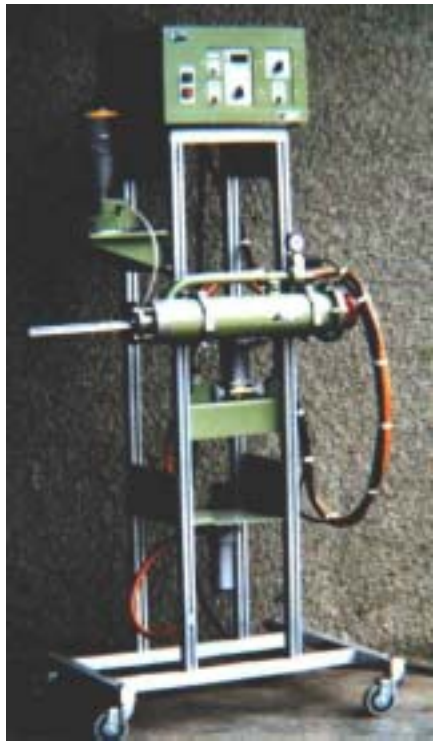
DYMET equipment to spray at 5 – 8 bars



- ceramic particles erode the nozzle
- powder injection downstream the nozzle critical section
- changeable nozzle elements
- decrease of deposition efficiency
- heated air of 2 000 l/min



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DYMET equipment to spray at 5 – 8 bars

- reduced air consumption to 400 l/min
- light weight manual spray gun
- changeable nozzle elements
- decrease of deposition efficiency

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DYMET equipment to spray at 5 – 8 bars

- different models of portable equipment
- simple to use
- minimal air supply 400 l/min
- minimal energy 3.5 kW
- deposition efficiency 20 – 30 %
- Al, Cu, Zn, Ni, Sn, Pb based powder mixtures
- Zr, Co, V, Fe, Ag are possible

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DYMET equipment to spray at 5 – 8 bars

- manual and automatic operation
- special powder mixtures

- production and restoration applications

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Production – local coatings

- Electrical engineering

- Cu at Al
- Al at Cu
- Sn at Cu
- Ni at Al

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Production – local coatings

- Cases for special electronic applications

- Cu at Ti (Al) cases
- Sn at Cu at Ti (Al) cases
- Zn at Steel cases

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Production – local coatings

- Anticorrosion coatings at welding lines of large hot galvanized constructions

- Zn

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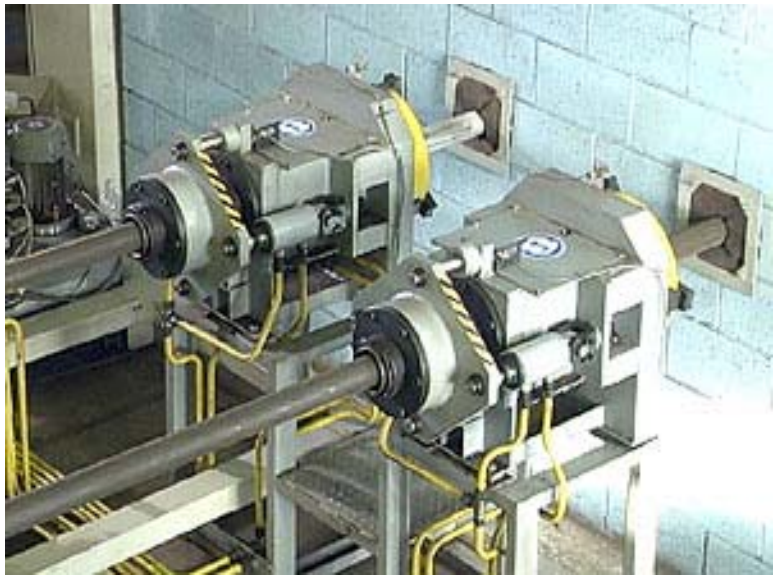
Production – local coatings

- Anti seizure coatings at screws of marine equipment and oil-well tubing
- Cu, Cu + Zn



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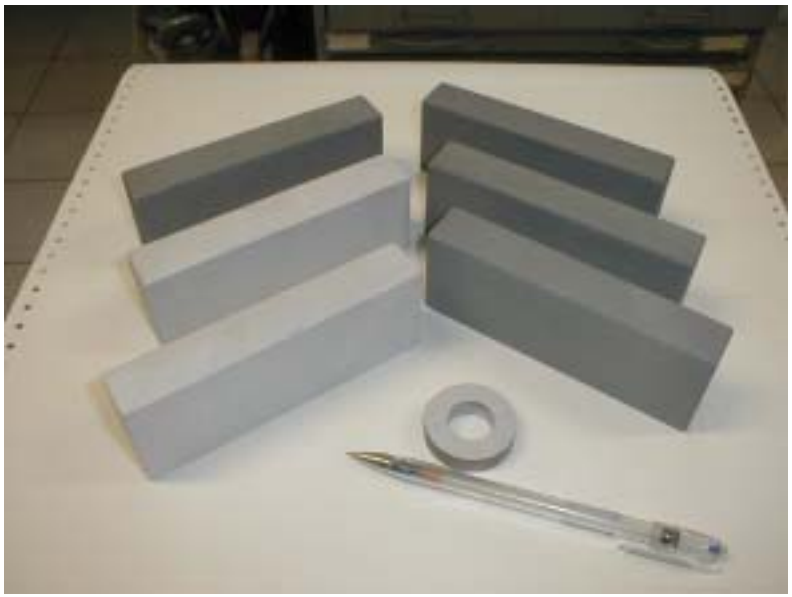
Production – local coatings

- Protective coatings at small – batch production
- Zn, Al, Cu, Ni, Sn, Pb



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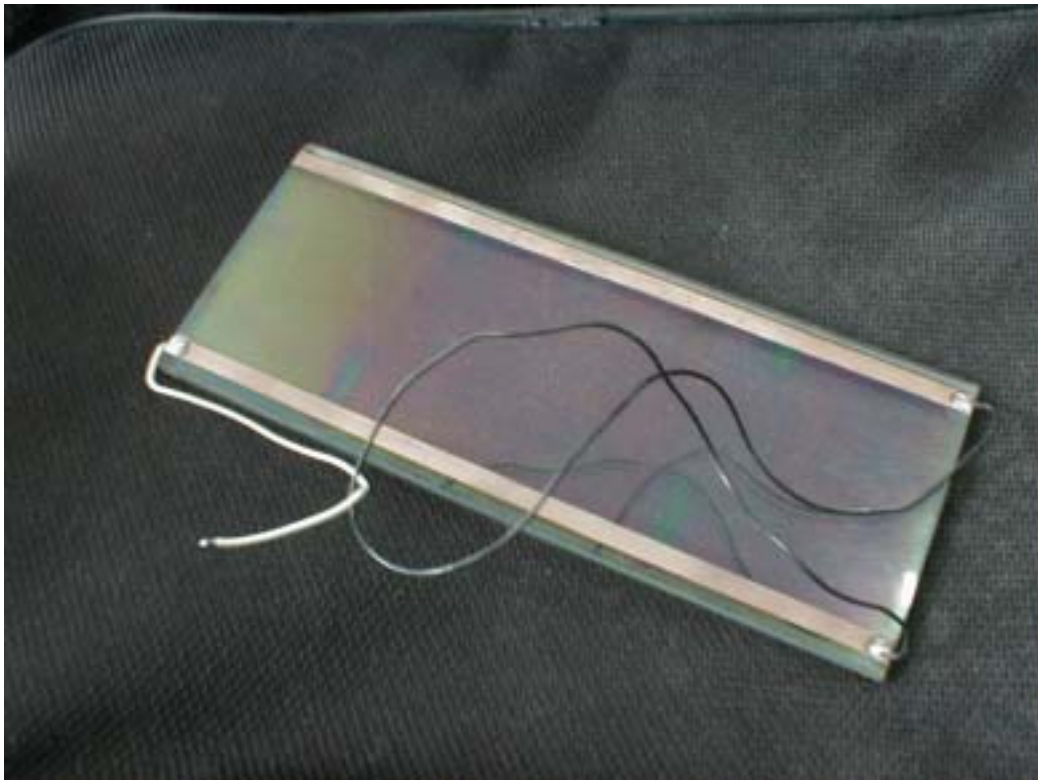
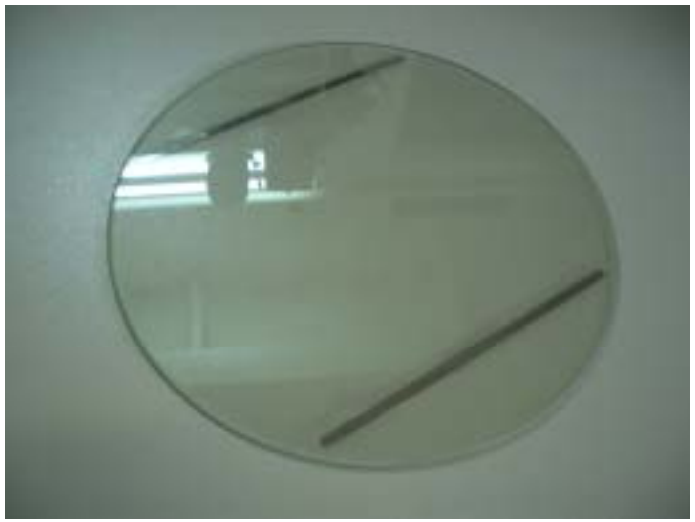
Production – unique coatings

- Electric contacts at special heated or controlled transparency glasses
- Al, Cu





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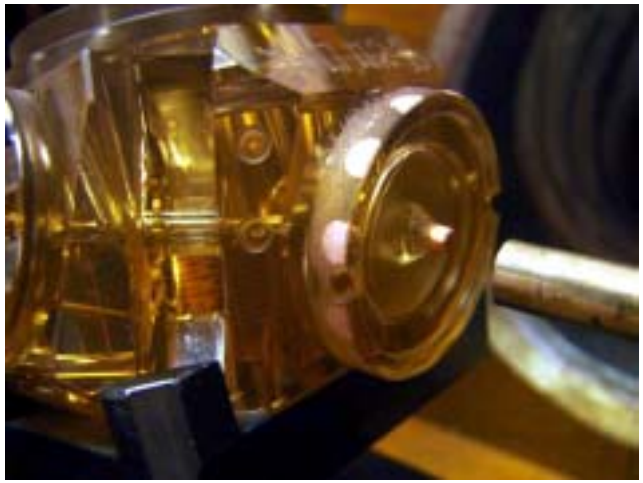
Production – unique coatings

- Electric contacts at special devices
- Al, Cu, Sn



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Production – Repair

- Casting defects

- Al, Al + Zn, Cu + Zn, Ni

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Production – Repair

- Casting defects
- Al, Al + Zn, Cu + Zn, Ni

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Production – Repair

- Machining defects
- Al, Al + Zn, Cu + Zn, Ni

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Production – Repair

- Machining defects – bearing seats

- Al, Cu + Zn, Ni

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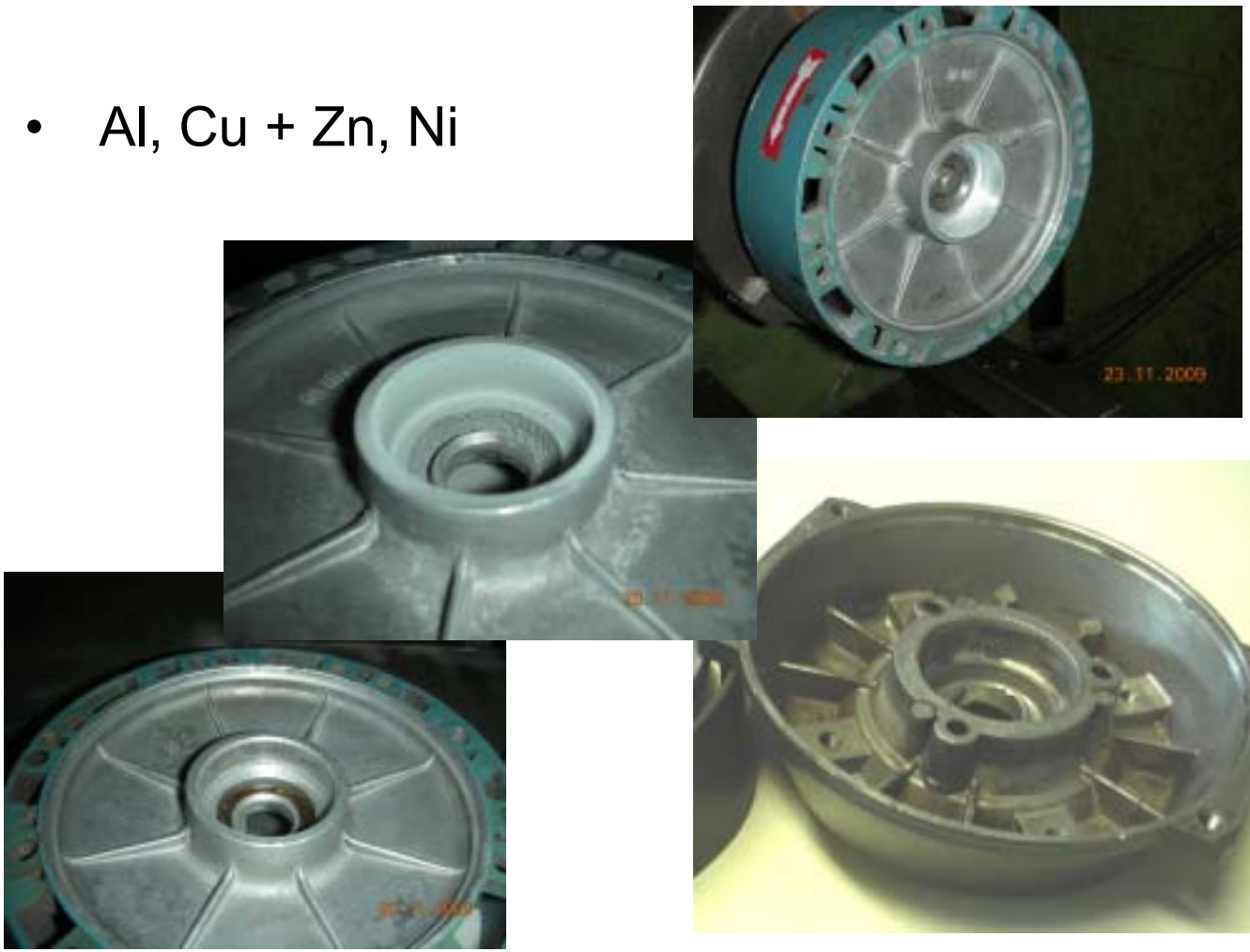
Repair - Renovation

- Wear of bearing seats
- Al, Cu + Zn, Ni



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Repair - Renovation

- Wear of bearing seats

- Al, Cu + Zn, Ni

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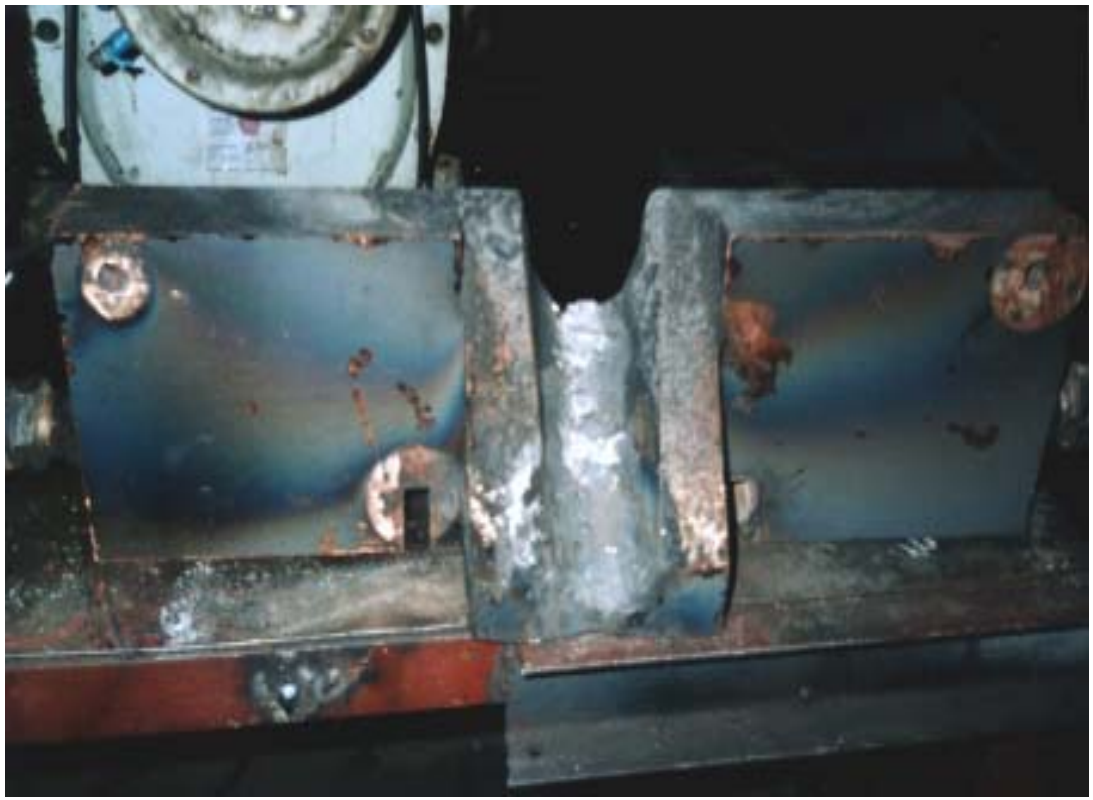
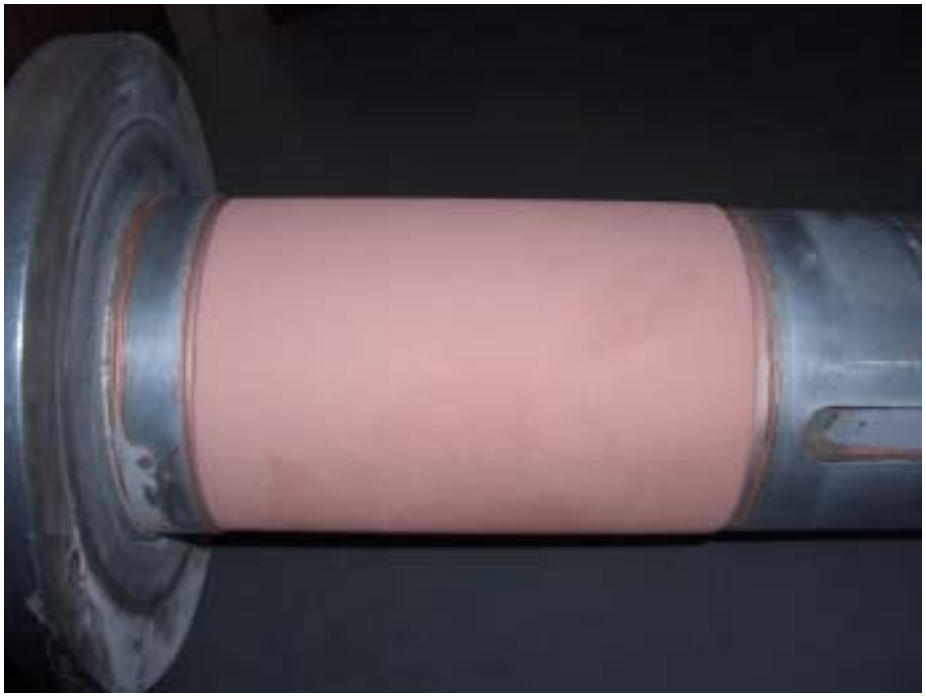
Repair - Renovation

- Wear of cooled copper auxiliaries
- Cu





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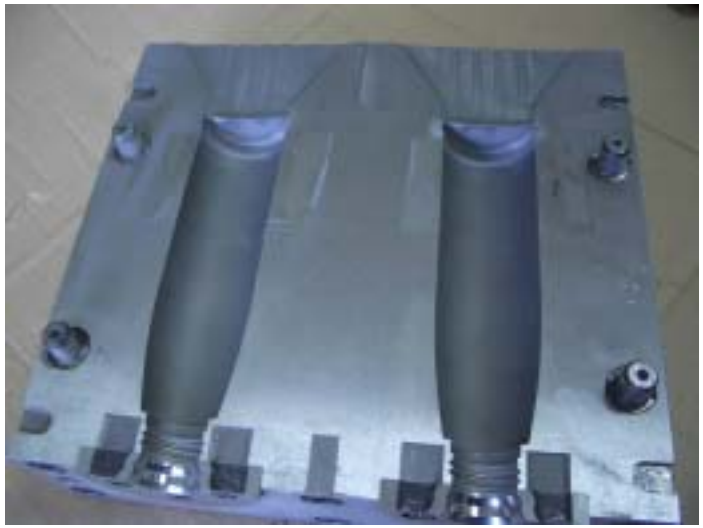
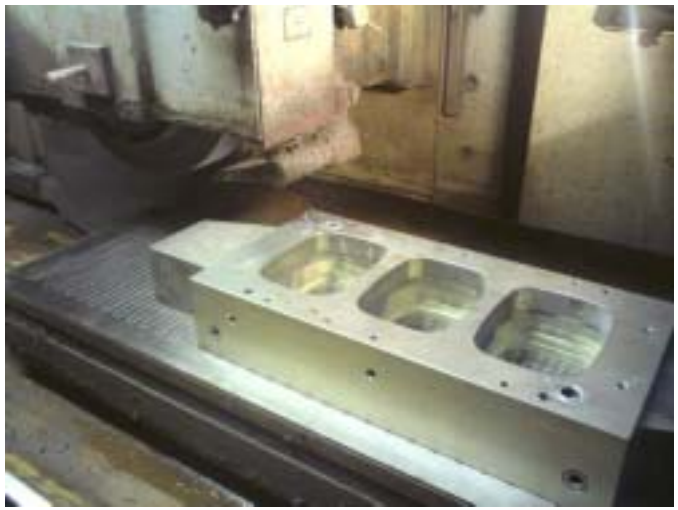
Repair - Renovation

- Defects at casting moulds
- Ni, Cu + Zn





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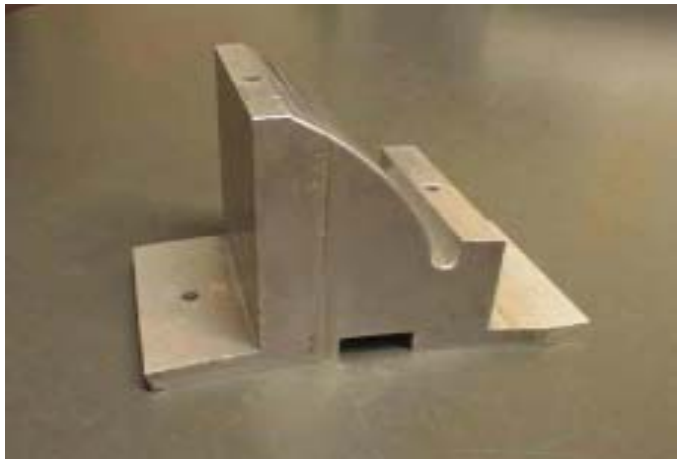
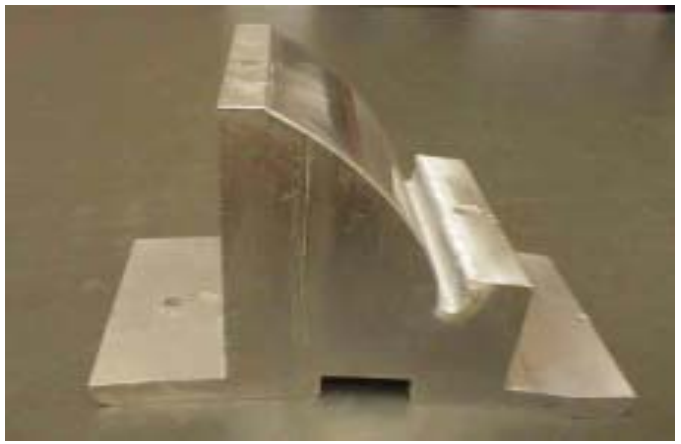
Repair - Renovation

- Casting moulds modification
- Al, Ni, Cu + Zn





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Repair - Renovation

- Defects at huge rolls

- Cu, Cu + Zn, Ni

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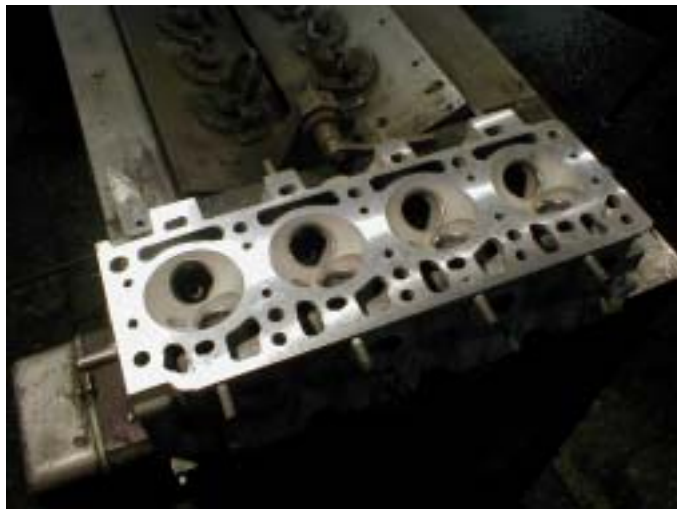
Repair - Renovation

- Automotive application at repair plants

- Al, Cu + Zn, Ni



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Repair - Renovation

- Automotive application at repair services

- Al, Cu + Zn, Ni

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Repair - Renovation

- Automotive application at repair services


- Al, Cu + Zn, Ni








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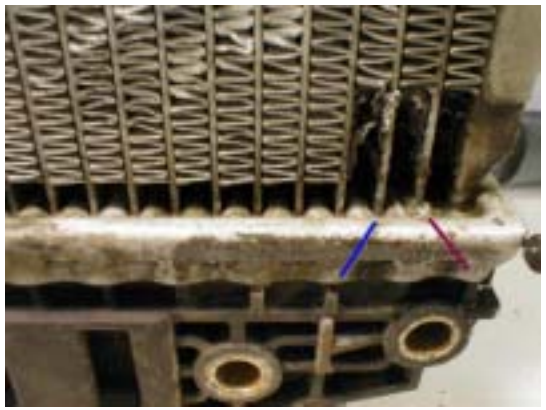
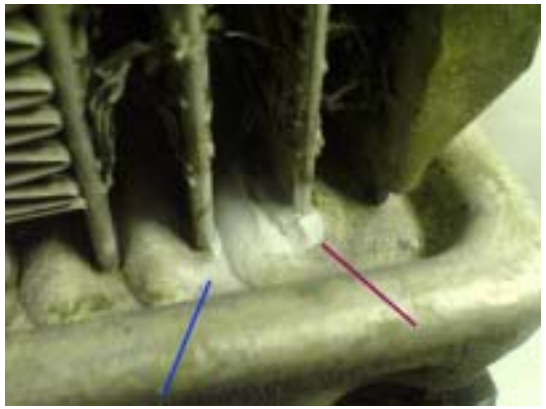
Repair - Sealing

- Radiators, pneumatic and hydraulic systems, vacuum and high pressure objects
- Al, Cu, Al + Zn, Cu + Zn



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Repair - Restoration

- Restoration of antique machines

- Al, Cu + Zn, Ni

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Repair - Restoration

- Restoration of antique sculptures

- Al, Cu + Zn, Ni

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Obninsk Center For Powder Spraying

- Careful customer education and technical support
- DYMET equipment at several technical universities
- Regional representatives
- Exhibitions and publications

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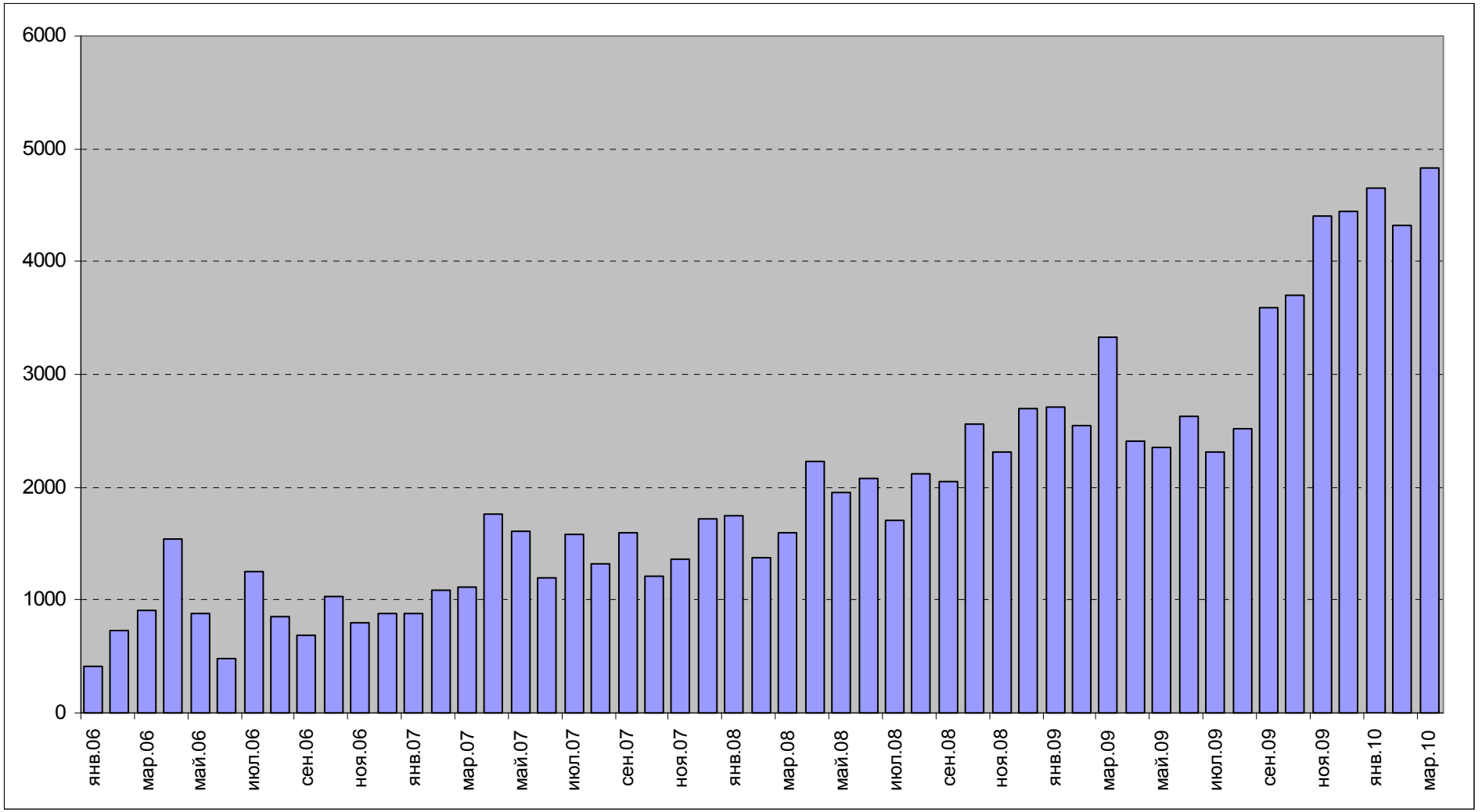

- DYMET technology supporting web-site
- monthly downloaded pages from DYMET technology web-site since 2006

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Thank You

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- Алхимов А.П., Косарев В.Ф., Папырин А.Н. **Метод "холодного" газодинамического напыления.** – ДАН СССР, 1990, т.315, с.1062-1065.

- Alkhimov A.P., Kosarev V.F., Papyrin A.N. **The metod of "cold" gas-dynamic spray.** – Doklady Akademii Nauk USSR, 1990, v.315, p.1062-1065.

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Letter to the Editor

Dear Dr. Moreau:

I enjoyed reading the paper you and your co-authors wrote for the December issue of the Spray Journal, entitled "Review on Cold Spray Process and Technology: Part I—Intellectual Property" (Ref 1), but I am perplexed why you describe the process, "….an all-solid-state coating process that uses a high-speed gas jet to accelerate powder particles toward a substrate where they plastically deform and consolidate upon impact," as "cold spray." Cold spray (literally) should not include spraying of a high melting point metal where the particles impact the work piece at over 1,000 °F and where the accelerating gas must first be heated to even higher temperature.

Jacobs, Hyland, and DeBonte (Ref 3) discuss the results obtained using HVAF spraying of WC-cermet coatings. The decrease of flame-jet temperature inhibited de-carburization effects yielding an improved coating sliding-wear behavior (compared to HVOF).

"The HVOF sprayed WC–CO-CR coatings showed a wear rate that was an order of magnitude higher than that of the HVAF WC–CO-CR coatings."

"This could be explained by the retention of WC particles and the absence of brittle W_2C, which is typical to the HVAF process."

A long, unhappy history is involved in the commercialization efforts of HVAF. Early in the 1990s, I was oper-

startling results. Spray impact widths using wire range down to ¼-in. with molybdenum even less. In the later case, a long single white-hot filament extends well beyond the sharp melting point. After traveling up to an inch break-up and atomization result in a very narrow droplet pattern, I plan to make this new HVOF wire spray method available to users at prices well below those of twin-wire-arc systems of comparable spray rate.

Jim Browning

References

1. E. Irissou, J.-G. Legoux, A.N. Ryabinin, B. Jodoin, and C. Moreau, Review on Cold Spray Process and Technology: