AlTx Summary

Scientific and technological development increases its demands to structural integrity and efficiency, requiring high tensile and high-strength materials with elevated-temperature strength capable of substituting steel and titanium in various constructions. In this regard superfast aluminum alloy crystallization opens a considerable prospect of creating new materials. The necessity of high mechanical and specific characteristics retention is one of the main problems of large-scale production of goods made of particles crystallized at high speeds of cooling.

1. High-strength aluminum alloys.

Simultaneous action of compressive fluid pressure and intensive shift/displacement deformations has beneficial effect upon bonding in the solid phase in the course of pressure welding, that accounting for the natural tendency of shift deformation enhancement and provision of properties' homogeneity in various ways.
The existing approaches to shift/displacement deformations intensification in different ways (lateral extrusion, work part curling in the container, "drawing-yielding-drawing"-type compacting, etc.) provide considerable elimination of these disadvantages and semiproduct / intermediate product quality enhancement. However due to the complexity of their realization, low performance, intermediate products range restriction, and deformation shift level insufficiency the latter cannot be used industrially.
These conditions can be fulfilled only in case of combination of compacting with twirling of the deformed material in the furnace of the deformation region.
Significant research was conducted in the domain of shift deformations in the course of compression's influence upon the structure and mechanical characteristics of powdery, granule and cast aluminum alloys, resulting in a new process flow scheme enabling us to create any wide range shift deformations with high hydrostatical pressure required. Being simple to realize, this scheme does not demand any structural alterations of the compression process.
Find sample testing results in the tables attached:

Table1. Physical and mechanical characteristics of powder aluminum alloy bars depending on the compression/compacting process flow scheme.

Compression scheme	Alloy	Physical and mechanical characteristics					
		Ultimate stress limit δb, MPa	Yield point δ0.2, MPa	Stretch ratio δ, %	Hardness, HB	Coefficient of thermal expansion	Elasticity modulus E, MPa
Conventional	1969+20%SiC	630	520	0.9	-	-	-
	1969	590	510	3,5	-	-	-
Hydraulic forging	1969+20%SiC	660	590	1,6	-	-	-
	1969	630	560	5,0	-	-	-
AlTx-HS	**1969+20%SiC**	**715**	**642**	**2,6**	**2100**	**11,6**	**11600**
	1969	**680**	**620**	**6,0**	**1500**	**21,6**	**7200**

Table 2. Mechanical characteristics of granulated aluminum alloys samples

Compression scheme	Alloy	Mechanical characteristics			
		Ultimate stress limit δb, MPa	Yield point δ0.2, MPa	Stretch ratio δ, %	Hardness, HB
Conventional	1959	644	550	11,5	1660

	1969	673	642	4,3	1910
AlTx	**1959**	**720**	**675**	**14,0**	**1850**
	1969	**752**	**719**	**5,0**	**2100**

Table 3. Mechanical characteristics of cast aluminum alloys

Compression scheme	**Alloy**	**Mechanical characteristics**			
		Ultimate stress limit δb, MPa	Yield point δ0.2, MPa	Stretch ratio δ, %	Hardness, HB
Conventional	B95	480	400	10,0	1400
	1420	465	312	14,0	-
AlTx	B95	510	420	15,0	1500
	1420	505	358	18,0	-

Thus the results of research of the suggested technological process with the use of additional shift deformations on account of work part curling in the swage of the matrix funnel as against conventional technologies show the expedience of wide use of the process, ensuring:

- obtainment of new materials with a high complex of mechanical and specific properties;
- uneven deformation distribution reduction;
- introduction of additional shift deformations in the course of extrusion, enhancing the level of physical characteristics of the material;
- abatement of the anisotropy of properties in axial and cross sections of the material with minimal elongation ratios;
- power consumption reduction;
- deformation temperature decrease.

The aforesaid technological process has been industrially tested at the leading aircraft manufacturing facilities, showing positive results.

Components and goods produced with the employment of this technology can be applied in various domains of technology, sports industry, PPEs, etc.

2. Conductor heat resistant alloys

Technical/commercial aluminum and low-helium Al-Mg-Si alloys are frequently used as conductor aluminum alloys. Operating temperature of electric wires made of aluminum alloys does not normally exceed 100°C. But at present it is necessary to enhance the temperature operation level of conductor aluminum alloys, granules metallurgy being the optimal method of production. Al-REM-based alloys seem to be the most perspective alloys for electric current conductors. Find physical characteristics of some aluminum alloys for electric current conductors.

Table 4. Physical characteristics of some aluminum alloys for electric current conductors.

	Ultimate stress limit δb, MPa	**Yield point δ0.2, MPa**	**Stretch ratio δ, %**	**Hardness, HB**	**Electric conductivity as to copper electric conductivity, %**
	20°C	250°	20°C	250°C	
A997	170	25	15	60	60
AD31	240	60	10	8	48
AlTx-P3M	**230**	**168**	**3**	**9**	**54**

Thus granulated aluminum alloys containing rare-earth metals possess high stable technological properties at high temperatures, corrosion resistance, high processibility, which allows production of high electric conductivity (Al-7%REM=0,031-0.032 m Ohm·m, which is 54% of copper electric conductivity and 90% of pure aluminum electric conductivity) micron cable/wire and can be applied for long operation at temperatures up to 150°C. 15%REM and more alloys have elevated-temperature strength and can operate at 300-350°C.

Yet this production is very expensive esp. owing to the indispensability of the granules degassing cycle for the process, the latter requiring sophisticated costly equipment, supplementary material costs, and excessive time consumption.

The developed procedure allows to avoid granule degassing on account of the developed briquets' compacting and annealing operating regimes. Sample testing shows that the whole complex of physical and specific characteristics peculiar to conventional methods of Al-REM-based alloys production is retained.