Development of import replacement technology for gunpowder production

A B Livshits, D V Pelipenko, V A Staroverov* and E L Matukhin

Federal government enterprise "Kazan state gunpowder factory"

Abstract. This article presented the results of the development of new grades of civil gunpowders, not previously produced at "KGTS", and the results of designing of new hunting and sports gunpowder for the shots of 12, 16, 20 shotgun caliber and for the hunting, sports and service rifles, that both presented at domestic and foreign production. Also, there are presented the results of a theoretical and methodological analysis of previous diversification and conversion, taking into account the need for a better solution of import issues and strategy of its implementation in the conditions of existence of external sanctions and restrictions. The market of foreign powders for small arms has been analyzed and foreign gunpowders have been investigated. The positive and negative aspects of the manufacturing technology of foreign powders and the physicochemical and ballistic characteristics of import powders are revealed. Currently relevant is the question of the transformation of the military-industrial complex in accordance with the needs of economic development and national defense of the country. An important emphasis is placed on solving the problems of import substitution and development of export-oriented technology, in particular powder production as a raw material for resourcing and expanding markets of final products sales.

In order to expand the range, increased output of gunpowder on the "KGTS" a large body of work was done in the direction of mass production of powders civil previously unreleased at the Kazan gunpowder factory. The choice of this area was connected with emerging consumer demand for civil powder for the manufacture of ammunition at assembly plants to small rifled and smooth bore weapons.

Practicing the process of the manufacturing process of these marks powders was carried out on existing equipment with manufacturing advanced prerelease samples, development, installation, adjustment and fine-tuning tooling, devices for training new additive dispensers for entering new components into the powder mass [1].

During the manufacturing process, physical-chemical, advanced ballistic test samples and optimum process parameters for the production phase: mixing a powder mass, pressing, cutting, dehydration, sorting, soaking and drying for each new brand gunpowder are determined.

For the new brands of powders processing conditions was developed and released, the means to conduct ballistic tests was acquired, methods of physical and chemical analysis was mastered, to determine their ballistic characteristics [2, 3].

As a result of this work, mass serial production of new grades of gunpowder and supplies them to the factories consumers was adjusted.

In 2003-2004, the domestic Russian market began to receive sport hunting gunpowder from a
foreign company. During this period, it was found that the nomenclature of sports hunting gunpowder is less in case of quantity compare to the foreign ones and was insufficient to provide increased consumer needs in Russia.

Therefore, the "KGTS" intensively carried out works in the direction of expanding the range and improve the quality characteristics of hunting and sporting gunpowder [3].

At the factory was developed and launched into a series a 17 brands of new hunting and sporting gunpowder for the shot of 12,16,20 caliber for rifles and hunting shotguns, sporting and service weapons, including import calibers 5.56 ÷ 9.0 mm.

From these, for the first in Russia was developed monobasic and dibasic pyroxylin-grained powder brands of the family "IRBIS", such "IRBIS PS", "IRBIS PN", "IRBIS-lugger M", "IRBIS-Lueger M", "IRBIS 223 Rem" "IRBIS-KARBAYN", "IRBIS 7,62h39", "IRBIS 308Win», «IRBIS 7.62x54R", "IRBIS 30-06S", «IRBIS 30-06SM», «IRBIS 338LM», «IRBIS VL-1 "" IRBIS VL-7 "," IRBIS 24 "," IRBIS 24 M ", I RBIS Sport 32 "," IRBIS Sports 32M "," snow leopard 410 "," IRBIS Hunting 35 "," IRBIS Hunting 35M "," IRBIS Magnum "," IRBIS Magnum M ".

Developed from the "KGTS" hunting and sports powders are commercially available, have a high level of quality and are available in amounts up to 50-60 tons per month for a Russian ammunition plant and for export.

When developing and testing powder manufacturing technology, selection of recipes, modes and parameters of the technology held by the results of a comprehensive analysis of process technology and the results of physical, chemical and ballistic testing advanced models and experiences of hunting parties powders.

During the execution of this works, technological parameters of manufacture of new propellants are specified, their adjustment to the phase - mixing, pressing, cutting, dehydration, sorting and soaking are held.

Technological and design documentation was developed and transferred to the production of gunpowder and the testing station. The plant organized mass serial production of new grades of hunting and sporting powders with improved output and quality characteristics, that provide predetermined design documentation parameters during ballistic tests quality: shot comfort improved by reducing the recoil energy, achieved reduction of elimination and sonority, decreased values fall of velocity at sub-zero temperatures.

Physico-chemical and ballistic characteristics of newly developed and improved, and mass-produced sports, and hunting gunpowder for smoothbore and rifled hunting, sporting and service weapons are given in Table 1.

From the data given in Table № 1 follows that the "IRBIS" powder family that was mastered by the plant of civil gunpowder and production development of new grades of hunting and sporting powders for smooth-bore 12, 16, 20 calibers, and for hunting, sports and service 5.45 .. 12.7 mm calibers are corresponded to the requirements of normative and technical documentation of the gunpowder and corresponded to the requirements of the design documentation for the cartridges.

At the plant technology was designed, and more than 1,000 lots of new brands of granulated and pyroxylin civil powders was maid. Their production was carried out according to the classical technology with the following operations:

- dehydration of pyroxylin in periodically operating centrifuges to alcohol-aqueous humidity of 29-34%, water humidity is not more than 4%;
- preparing K2SO4, KO3, ceresin and others components. Packaging them in sealed containers and sending to plasticization phase;
- plasticizing of pyroxylin in periodically - operating stir device by alcohol-ether solvent with input components included in the formulation of powders, powder crumb standard mass and processing them in stir device during 1h 20min - 1h 30min;
- filtering the powder mass in hydraulic Buhler presses with pressure of filtration around 180-250 kgf / cm2;
- pressing the powder filtrate in a hydraulic Buhler press at a pressure of 280-350kgf / cm2 through
a press tool, individual to each chosen brand gunpowder;
- acceptance of powder cords, wilting, cutting for a predetermined length;
- wilting of powder in periodically - operating wilting apparatus;
- classification of powders on 'Moro' devices and inclined sieve apparatus for the separation of non-defective fraction from large and fine grain;
- solvent removal process in water, drying and mixing of powders on existing equipment with packaging in a sealed container;
- conducting physical, chemical and ballistic tests for compliance with specification.

The production cycle for producing porous and granulated civil powders differs from the classical manufacturing production cycle nonporous, pyroxylin, granulated powder as follows:
- in the production cycle the phase of preparation of water-soluble salts takes place, including their grinding, drying, sieving with sieves, packaging in sealed containers for transport to the plasticization phase;
- productivity of equipment (mixing devices, presses, cutting machines, the sorting apparatus, solvent removal devices) in connection with the introduction of a powder mass of water-soluble salts is reduced by the value of their input;
- due to the presence of the water-soluble salt in powder duration of solvent removal process in water process is increased.

Other processes of manufacture of new grades of porous, non-porous, granulated, pyroxylin civilian gunpowder in case of labor intensity are the same.

**Table 1. Use of the powders of the "IRBIS" family**

| Gunpowder brand | Use | Standart |
|-----------------|-----|----------|
| Irves-410 | For hunting 410 caliber shotgun cartridges | TU 7277-047-13999838-2012 |
| Irvis 410M | For shot and bullet hunting cartridges of caliber 410 for a smooth-bore weapon | TU 7277-047-13999838-2012 |
| Irbis 24 | For sporting shotgun cartridges 12 caliber casings «TRAP», «SKEET», «SPORTING» | TU 7277-013-13999838-2006 |
| Irbis 24G | For hunting smooth-bore shotguns 12 caliber | TU 7277-017-13999838-2007 |
| Sports Irves-32 M Hunting 35-ounce, 35 ounce, Hunt M | For the shot and the bullet cartridges 12, 16, 20 calibers for smooth-caliber hunting guns | TU 7277-015-13999838-2007 |
| Irbis-Magnum | For hunting shot or bullet 12, 16, 20 calibers for smooth-bore guns | TU 7277-024-13999838-2008 |
| Irbis-PN | For pistol cartridges 357 Magnum caliber (revolver), 9 mm Luger FMG, 9 mm Luger NR | TU 7277-046-13999838-2012 |
| Irbis-Luger | For sports pistol bullet cartridge 9mm Luger | TU 7277-014-13999838-2006 |
| Irves-M Luger | For sports pistol cartridge 9mm Luger | TU 7277-014-13999838-2006 |
| Irbis 223 Rem | For sporting and hunting cartridges of calibers 223Rem (5,56h45) and 308Win (7,62h51) to weapons with a rifled barrel channel | TU 20.51.11-060-13999838-2016 |
| Irbis-Karbayn | For sporting and hunting bullet cartridge 7,62h33 for 7,62 Carbine "30 Carbine" | TU 20.51.11-062-13999838-2017 |
| Irbis 7,62h39 | For hunting cartridges for hunting weapons 7,62h39 7,62 | TU 20.51.11-058-13999838-2016 |
| Irbis 7,62 Win | For hunting and sporting bullet caliber 7,62h51 (308 Win) for the sporting and hunting rifles | TU 20.51.11-057-13999838-2016 |
| Irbis 7,62x54R | For hunting cartridges 7,62x54R caliber bullet weighing 9.6 g, 9.65-9.85 c, 11.3 g, and c 11.6-11.8 7,62x54 caliber bullets weighing 9.45-9.47 gr. | TU 20.51.11-056-13999838-2017 |
| Irbis 30-06S | For hunting bullet cartridges with bullets 7,62x63 9.01 grams, 9.4 grams, 10.9 grams for hunting weapons 7.62 | TU 20.51.11-056-13999838-2017 |
| Irbis 30-06SM | For hunting bullet cartridges 7,62x63 with a bullet of 13.0 grams for hunting weapons 7.62 | TU 20.51.11-063-13999838-2016 |
| Irbis VL-1 | For hunting equipment 12,7x108 caliber for different types of caliber weapon with a rifled barrel 12,7x108 channel | TU 20.51.11-063-13999838-2016 |
Conclusions
For the new developing brands of civil hunting and sporting gunpowder technical documentation and technical conditions was released.

Mastered by the factory technology and release of new grades of civilian gunpowder allows to reliably provide their production without remarks on the quality from the consumers.

Manufactured on "KGTS" civil gunpowder provides the whole market of hunting and sporting gunpowder for smooth bore guns 12, 16,20 and 410 calibers and rifles from 5.45 to 12.7 mm both foreign and domestic production.

References
[1] Gindich V.I. 1995 Technology of pyroxylin powders. Gunpowder production (Kazan: GosNIIHP, 396 p).
[2] Belyaev A.F. 1968 Combustion, detonation and explosion of condensed systems (M.: Science).
[3] Staroverov V.A. 2013 Mathematical modeling of the optimization of the geometry of molecular systems using the program complex ACCELRYS / Herald of Kazan Technological University, Kazan, Volume 16, No. 10 p.306-310