Efficient Engineering: Ideas from Russia, Equipment from Taiwan... and Not Only

Engineering is a field of activity in which the basis of the seed capital create ideas. This is where small innovative companies can achieve considerable success without the help of outside investors. In this regard, very illustrative is the example of the TERLA, Moscow-based company. For several years in the field of vacuum systems engineering she participated in equipping and modernization of the largest Russian research and production enterprises from various industries. An important success factor is established cooperation with foreign partners, in particular with the Taiwanese company Hanbell Precise Machinery, which develops and manufactures modern dry screw vacuum pumps. Yury Vassiliev, the director of business development of TERLA, and Hong-Sheng Fang, president of Hanbell, told us about collaboration between the Moscow and Taiwanese companies, solutions offered to customers, peculiarities of the Russian market and about numerous projects.

How did the alliance "TERLA" and Hanbell in the Russian market? Yury Vassiliev: "TERLA" was created in 2012, but the employees of our company have had experience working with Hanbell since 2008. At that time, screw vacuum pumps of this brand already had a good reputation on the international market, and our own experience only confirmed their high quality.

Hong-Sheng Fang: We have known specialists of the company "TERLA" and did not hesitate in their highest qualifications as in technical area, and in the organization of sales and customer service.

What is the reason for the successful advance of the equipment Hanbell in Russia and the world?
Why TERLA and Hanbell began to cooperate in the Russian market?

Yury Vassiliev: TERLA was created in 2012, but our employees have experience with Hanbell since 2008. At that time Hanbell dry screw vacuum pumps already had a good reputation in the international market, and our own experience only confirmed their high quality.

Hong-Sheng Fang: For many years we know specialists of TERLA and are absolutely sure of their highest qualification in the technical field as well as in sales and service.

What determined the success of the Hanbell vacuum pumps in Russia and in the world?

Hong-Sheng Fang: Hanbell since 1994 develops and manufactures vacuum equipment. Although in comparison with competitors we are a young company, we have accumulated a lot of experience in the production of reliable dry screw vacuum pumps, whose technical capabilities meet the highest world standards. The dynamics of growth of sales is so great that our goal is to become one of the five leaders of this market segment.

There are four key factors that have enabled us to make rapid progress. First, we pay great attention to the development of not only sales, but also customer support: our customers can seek help from the headquarter in Taiwan, 13 service centers in China, offices in Italy and Vietnam, numerous distributors in Europe and Asia, Russia and the USA. Secondly, our dry screw vacuum pumps have a number of important technical advantages: high performance, due to excellent rotor profile sealing effects; short gas path reduce the contamination of process gas; simple design, reliability and maintainability; water cooling canned motor provides high safety.
standard; microprocessor controller and remote control software protect pump from abnormal situations. Thirdly, we can not only adapt our equipment to the customer’s requirements, but also to develop an exclusive solution, if necessary. Finally, it should be noted that with all these advantages, our dry screw vacuum pumps are cheaper than counterparts.

I would like to emphasize that Hanbell is a powerful company, which has been ratified as "important technical corporation" by Industrial Development Bureau, Ministry of Economic Affairs. We have two production facilities in Taiwan and one in China, with a total area of about 60,000 sq.m. Much attention is paid to R&D, improvement of technologies and products. High efficiency of vacuum pumps is achieved, in particular due to the special design of the screw, which is our own development. We produce vacuum pumps with capacities from 80 to 800 m³/h, which provides a vacuum to 10⁻³ Torr, and can be used for vacuum degassing, vacuum drying, space simulations, in vacuum metallurgy, chemical industry, semiconductor industry.

Yury Vassiliev: I would like to supplement the story with a few examples that confirm the quality and reliability of the Hanbell equipment. One of the installed vacuum pumps operates with the old vacuum furnace, in which filters are burned-out. The soot particles are deposited inside the pump and, mixing with the condensate to form a solid powder, which eventually blocks the shafts. The pump stops, but doesn’t break down – after cleaning the system starts to work again without decrease in performance. At another enterprise there was a case when the vacuum pump has overheated after long-time work in flows of gas, and the steel shafts began to rub each other. However, cooled down, the pump started working again with the same efficiency.

The electronic components of the Hanbell equipment also been tested for reliability in Russian conditions. For example, in NPO Lavochkin there was a case when instead of 380 V voltage has reached 500 V, and the pumps stopped. But it turned out that only automatic safety locks were switched off and electronics were not damaged. In the same plant in one of the processes of degassing very large amount of moisture was exuded. So much that from the outlet flange of the pump the condensed water flowed, but, nevertheless, the pump continued to work and works properly until now.
How do you assess the Russian market of vacuum equipment? What are its specific features?

Hong-Sheng Fang: We believe that the Russian market has a very good potential. There are all preconditions for the development: high level of innovation, the availability of a skilled workforce, vast natural resources. The economic downturn due to the devaluation of the national currency will soon be over, replaced by rapid growth.

Yury Vassiliev: If we talk about the specifics, in Russia the main customers of vacuum systems – enterprises of the military and space industry. Production of semiconductor devices, which is the main market for Hanbell in Taiwan, in Russia, first, is relatively poorly developed, and secondly, mainly focused on the closed solution of certain manufacturers. Companies that produce small machines for the deposition of thin film coatings for semiconductor industry, buy vacuum pumps, but usually try to choose what is cheaper. It should be noted that Hanbell offers one of the best price in the segment of industrial dry pumps, but they, firstly, have a relatively large weight – from 200 kg, secondly, standard models require water cooling, which is suitable not for all customers (but version with air cooling are also available).

Another feature of the Russian market is a large amount of equipment operating from the Soviet era. Fortunately, now there is a noticeable trend towards modernization: obsolete vacuum systems are replaced by modern, providing dry vacuum; new devices for control of the vacuum and other technological parameters are installed; the automation increases.

In connection with the automation should mention the problem of staff – the older generation of professionals gradually leaving the stage, and the new generation is not always ready to receive the knowledge and skills of their predecessors. In enterprises where work both experienced and young technicians can clearly see the difference in approaches: the first set up the hardware settings manually, the latter rely on the automation.

Is it possible to consider that the introduction of dry pumps is technologically necessary and economically justified?

Hong-Sheng Fang: The exclusion of lubricants and fluids provide high purity gas environment, as well as the reliability and versatility of the pump. Dry vacuum pumps are successfully working with aggressive gases and gases containing solid particles.
в сегменте промышленных безмасляных насосов, они, во-первых, имеют сравнительно большой вес – от 200 кг, во-вторых, стандартные модели требуют водяного охлаждения, что подходит не всем заказчикам, но при этом есть версии и с воздушным охлаждением.

Еще одна особенность российского рынка – большое количество оборудования, работающего еще с советских времен. К счастью, сейчас заметна тенденция к модернизации: устаревшие системы откачки на базе насосов с масляным уплотнением заменяются современными, обеспечивающими безмасляный вакуум; устанавливаются новые средства контроля вакуума и других технологических параметров; повышается автоматизация управления.

В связи с автоматизацией следует упомянуть и о проблеме кадров – старое поколение специалистов, которые привыкли все настраивать самостоятельно, постепенно сходит со сцены, а новое поколение не всегда готово перенимать знания и навыки предшественников. На предприятиях, где работают и опытные, и молодые специалисты, четко видна разница в подходах: первые настраивают параметры оборудования вручную, вторые полагаются на средства автоматизации.

На сколько технологически необходима и экономически оправдана замена "масляных" насосов на безмасляные?

Гон-Шен Фанг: Исключение смазок и рабочих жидкостей обеспечивает высокую чистоту газовой среды, а также надежность и универсальность насоса. Безмасляные винтовые вакуумные насосы успешно работают с агрессивными и содержащими твердые частицы газами. При этом они требуют минимальных затрат на техническое обслуживание.

Юрий Васильев: Для многих областей, например испытаний космической техники, принципиально, чтобы вакуум был безмасляным, так как даже тончайшая масляная пленка меняет свойства объектов, снижая достоверность результатов тестов. Наличие частиц масла в вакууме нежелательно и при нанесении тонкопленочных покрытий, формировании наноразмерных структур, а также в других высокоточных технологических процессах.

При модернизации старых установок следует учитывать, что насосы последних поколений значительно экономичнее, чем те, что выпускались несколько десятилетий назад. Например,

particles. Besides, they require minimal maintenance costs.

Yury Vassiliev: For many areas, for example, for testing of space technology it is crucial that the vacuum was oil-free, as even the thinnest oil film changes the properties of the objects, reducing the reliability of the test results. The content of the oil particles in vacuum and undesirable deposition of thin film coatings forming nanoscale structures, but also in other precision processes. Presence of oil particles in vacuum is undesirable also in thin-film deposition, forming nanostructures, and in other high-precision technological processes.

When upgrading old plants should be taken into account that the latest generation of vacuum pumps is much more economical than those that were produced decades ago. For example, when we upgraded the plant in the VILS, the old pumps with electric power of 56 kW were replaced with modern Hanbell vacuum pumps, which provided the same performance at a power of 10 kW. A simple calculation shows that only by reducing energy costs the new pumps will be repaid over three years. In addition, there are no oil costs, reduced maintenance costs and are excluded stoppings due to the periodic occasions of the emissions of oils.

What are the main directions of improvement of dry vacuum pumps?

Hong-Sheng Fang: There are three important trends: reduction of the dimensions of the equipment, increasing of productivity and reducing of energy consumption. At the same time, we try as much as possible to meet the users’ requirements who want to get better equipment for less money. Also it should be noted that the screw vacuum pumps are becoming more versatile. Figuratively speaking, if earlier six applications require the same number of different models of pumps, it is now quite the same model.

Let’s talk in more detail about TERLA. How did the idea to create an engineering company?

Yury Vassiliev: Since 2008, I was the CEO and co-founder of ACTAN company, where a team of professionals with extensive experience in implementing complex projects in the field of vacuum equipment was gathered, so the choice of specialization was natural. By 2012, it became clear that our team had outgrown ACTAN, which was primarily engaged in the resale of the process equipment. In TERLA we decided to build a business on...
когда мы переоснащали технологическую устаревшую во Всероссийском институте легких сплавов, то старые насосы мощностью 56 кВт были заменены на современные Hanbell, обеспечивающие такую же производительность при мощности 10 кВт. Простой расчет показал, что только за счет снижения затрат на электроэнергию новые насосы окупятся за три года. Плюс к этому отсутствуют расходы на масло, снижаются затраты на обслуживание и исключаются остановки из-за периодически случавшихся выбросов масла.

Каковы направления совершенствования безмасляных винтовых вакуумных насосов?

Гон-Шен Фанг: Можно отметить три основные тенденции: уменьшение габаритных размеров оборудования, рост производительности и сокращение энергопотребления. При этом мы стараемся по возможности идти навстречу пользователям, которые хотят получать лучшее оборудование за меньшие деньги. Также можно отметить, что винтовые вакуумные насосы становятся все более универсальными. Образно говоря, если раньше для шести областей применения требовалось столько же разных моделей насосов, то теперь достаточно одной модели.

Давайте более подробно поговорим о бизнесе компании "ТЕРЛА". Как появилась идея создать инжиниринговую компанию?

Юрий Васильев: С 2008 года я был генеральным директором и соучредителем компании "АКТАН", где собиралась команда высококвалифицированных специалистов, имеющих большой опыт реализации сложных проектов в области вакуумного оборудования, поэтому выбор специализации напрашивался. К 2012 году стало понятно, что наша команда переросла рамки компании "АКТАН", занимавшейся преимущественно перепродажей технологического оборудования. В компании "ТЕРЛА" мы решили построить бизнес на предоставлении клиентам комплексных решений для выполнения различных задач в области вакуумной и криогенной техники, а также оборудования для термической обработки.

В настоящее время пять из восьми сотрудников - технические специалисты в области вакуумной, криогенной и термовакуумной техники, в том числе двое имеют научную

providing customers with comprehensive solutions for different tasks in the areas of vacuum and cryogenic technology and equipment for heat treatment.

Currently five of the eight employees are technicians in the field of vacuum, cryogenic and thermal vacuum equipment, including the two have an academic degree, three worked at the Vekshinsky Research Institute for Vacuum Machinery, one was educated and worked for a long time in the USA.

If the majority of your employees are technicians, who sells?

Yury Vassiliev: Since the vacuum equipment is rather complicated, and effective work with customers requires a deep understanding of its features, the sale is part of the function of our technicians. One of the problems is that the customer is often initially interested in devices that are not optimal or not suitable for his tasks, so our specialist must understand what is required and offer the most rational decision. For example, if the requested model of equipment has excess capabilities, we offer a more simple and economical solution.

In fact, every project starts with technical expertise, and, in the case of complex systems, we go to the customers to assess their needs. This practice helps to avoid mistakes that is beneficial to both parties: customers receive optimal solution, and we eliminate a lot of problems that arise when a customer is dissatisfied with the operation of the equipment.

What are competitive advantages of TERLA in comparison with several dozen of other Russian companies that specialize in engineering in the field of vacuum equipment?

Yury Vassiliev: First, we offer products of our own design, technical parameters and quality of which are not inferior or superior to competing systems, and, at the same time, which have a very attractive price.

Secondly, we provide our customers with comprehensive technical support from consultations at the stage of selection of solutions to maintenance of the installed equipment. In particular, we are the only ones who not only sells, but also maintains and repairs Hanbell vacuum pumps in Russia.

What types of equipment are proprietary developments of TERLA?

Yury Vassiliev: We develop vacuum gauges, cryogenic vacuum pumps, systems for liquefaction of nitrogen from air, vacuum drying
Ovens and systems for testing and processing of devices operating in open space. We order vacuum gauges in China, and controllers for them are assembled in St. Petersburg. The cryogenic vacuum pumps and systems for liquefaction of nitrogen are produced for specific projects from the components ordered in the different countries. All kinds of equipment are adapted to customer requirements, for example, cryogenic vacuum pumps can be equipped with any flanges – both standard and non-standard. Systems for space simulation, vacuum degassing, etc., are individual projects, which are implemented from scratch.

Where are manufactured the components for the equipment?

Yury Vassiliev: Most of the parts are imported from USA, UK, Switzerland, Germany, France, Taiwan, China, Korea, Japan. In Russia boards for the controllers are made, but the body and displays are imported from China. Steel components for vacuum chambers, as a rule, we order in Korea, because in Russia cannot be achieved the required quality of metal processing, in particular, there are no facilities for electropolishing of large parts. If the customer is satisfied with lower accuracy and requires short delivery times, then it is possible to use the products of domestic metal processing, although the worst quality its price will be the same as at the Koreans. Our principle is not to skimp on the details and we use only high quality components. Thanks to this, we and our customers are sure in the reliability of equipment.

How the economic sanctions affect your business?

Yury Vassiliev: Paradoxically, but sanctions stimulate the development of our company. Customers are interested that the equipment was supplied with consumables and spare parts, therefore they give preference to the Russian developments and the Asian equipment. In part thanks to the sanctions, we have started to produce high-performance cryogenic vacuum pumps. This type of equipment is used primarily in the aerospace and defense industry, and the leading foreign supplier is a Swiss company. After the imposition of sanctions, we started production on the basis of cryogenic refrigerator by SHI Cryogenics and using our own developments, which got the state prize in 2002. As a result, we can offer systems...
of excellent quality and reliability for the smaller price.
Also sanctions stimulated the development of our cooperation with Chinese suppliers. It should be noted that Chinese products are getting better in quality, although the price difference with the European products of the same level has dropped to approximately 10-20%. Chinese partners provide us with a "plan B" in case of a complete break in relations with the European and North American companies. "Plan C" is also available: if foreign products become unavailable, we will use Russian developments. To ensure our customers quality service regardless of the international situation, we plan to organize a partial assembly and modernization of dry vacuum pumps in Russia (preliminary agreements have been reached with Hanbell).

You mentioned the receiving of the state prize...
Yury Vassiliev: We got the prize for complex of developments in the field of cryogenic vacuum technology, which we began in graduate school of MPEI, and then continued in the Vekshinsky Research Institute for Vacuum Machinery. The scientific group, besides me, included Alexander Androsov and Olga Zilova, research supervisor was Sergey Nesterov. We carried out joint developments with APD Cryogenics (USA), which later became a member of the SHI Cryogenics group. Also in collaboration with the Efremov Institute (NIIEFA) participated in the ITER project (International Thermonuclear Experimental Reactor). As a result, in 2002 by the decree of the President of Russian Federation we were awarded the State prize for young scientists for...
outstanding work in the field of science and technology.

What you will present at VacuumTechExpo 2015?
Yury Vassiliev: First, the Pirani vacuum gauges for measuring pressures in the range from 750 to 10^{-3} Torr. The device consists of a sensor in the case from stainless steel, aluminum or glass with different types of connections, and of a dual channel controller with LED display, which allows to display the values of pressures in PA, Torr or mbar from both channels simultaneously. The controller has analog and digital outputs for connecting to external systems.

Secondly, we will present the cryogenic pumps for dry pumping of large vacuum chambers with a capacity from 15,000 to 65,000 l/s, which provide the residual pressure to 10^{-7}–10^{-8} Torr. The cryogenic pumps can be made with any type of a flange from 500 to 1250 mm in size.

The third group of products are high-vacuum ovens with a chamber capacity from 20 to 500 liters, which are intended for drying, degassing, evaporation, heating of metal parts for surface treatment, curing, testing, calibration of barometers and other tasks. The residual pressure is up to 10^{-5}–10^{-6} Torr and the heating temperature – up to 300°C.

Our systems for simulating space conditions can be equipped with the vacuum chamber with capacity up to 18 m³ and more. The vacuum is created by dry cryogenic vacuum and screw pumps. Thermal effect in the range from 80 to 450 K (-193 – +177°C) is simulated. The system can be used for testing of equipment, leak testing and degassing.

The fifth group of products – systems for liquefaction of nitrogen from air with productivity from 6 to 120 l/day. Maximum purity of gas – 99.995%. The system can be air- or water-cooled and operate in automatic mode.

How do you plan to develop your business in the future?
Yury Vassiliev: As any company, which is adjusted on success and development, we plan to expand our business if external economic environment allow. First of all it concerns the improvement of our products, as well as the bringing to market new innovative solutions.

Thanks for the interesting interview.
АРД Cryogenics (США), которая позднее стала частью группы SHI Cryogenics. Также совместно с НИИ электротермической аппаратуры им. Д.В.Ефремова участвовали в проекте международного экспериментального термоядерного реактора ITER. В результате указом президента нам была присуждена Государственная премия 2002 года для молодых ученых за выдающиеся работы в области науки и техники.

Какие разработки "ТЕРЛА" будут представлены на "ВакуумТехЭкспо 2015"?
Юрий Васильев: Во-первых, вакуумметры Пирана для измерения давлений в диапазоне от 750 до \(10^{-3}\) Торр. Прибор состоит из сенсора в корпусе из нержавеющей стали, алюминия или стекла. С различными типами присоединения, и двухканального контроллера с LED-дисплеем, который позволяет отображать значения давлений в Па, Торр или мбар с обоих каналов одновременно. Контроллер имеет аналоговые и цифровые выходы для подключения к внешним системам.

Во-вторых, представим крионасосы для безмасляной откачки больших вакуумных камер с производительностью от 15 тыс. до 65 тыс. л/с, которые обеспечивают предельное остаточное давление до \(10^{-7}-10^{-8}\) Торр. Крионасосы могут быть изготовлены с любым типом фланца размером от 500 до 1250 мм.

Третья группа продуктов – высоковакуумные термощафы с камерой объемом от 20 до 500 л, применяемые для сушки, дегазации, выпаривания, нагрева металлических деталей для поверхностной обработки, полимеризации, проведения испытаний, калибровки барометров и других задач. Предельное остаточное давление составляет до \(10^{-5}-10^{-6}\) Торр, а температура нагрева – до 300°С.

Разрабатываемые нашей компанией системы имитации космических условий комплектуются вакуумной камерой объемом до 18 м³ и больше. Вакуум создают безмасляные криовакуумный и винтовой насосы. Имитируются температурные воздействия на объект в диапазоне от 80 до 300 К (-193 – +177°С). Система может использоваться как для проведения испытаний оборудования, так и для проверки на герметичность и обеззагивания объектов.

Пятая группа продуктов – установки для получения жидкого азота из окружающего воздуха производительностью от 6 до 120 л/сут. Максимальная степень чистоты газа – 99,995%. Системы могут иметь воздушное или водяное охлаждение и работают в автоматическом режиме.

Планируете ли расширять бизнес?
Юрий Васильев: Как любая настроенная на успех и развитие компания мы планируем расширять свой бизнес, если позволят внешние экономические условия. Прежде всего это касается совершенствования выпускаемой, а также вывода на рынок новой инновационной продукции.

Спасибо за интересный рассказ.
С Юрием Васильевым и Гон-Шен Фангом беседовали Дмитрий Гудилин и Олеся Лаврентьева