Proposing new value through the use of oil-based inks to achieve high-speed drying

RISO KAGAKU CORPORATION

Sales of RISO's inkjet full-color production printer VALEZUS T2100, which had an advance release in Europe and the US and has been on sale there since 2019, launched in Japan in March 2021. This machine uses oil-based pigment ink to achieve high productivity, low energy consumption, and a small footprint. It can print 320 pages in full-color A4 size per minute at a low cost, and with this release RISO is proposing a new cost-balance ratio in comparison with water-based ink digital printers. As a result of these features, this model could become a leading digital printer in the low-cost data printing category.

Creating fundamentally unique products

RISO KAGAKU CORPORATION was founded in 1946 as a mimeograph printing company called "RISO-SHA," with its headquarters in Setagaya Ward, Tokyo. When RISO-SHA had problems importing ink for its printing operations, the company developed its own proprietary ink technology, and this became the impetus for the company's shift to its current business model as an office materials and equipment manufacturer. The "RISO Ink" developed in 1954 was the first emulsion ink in Japan, and RISO-SHA launched its sales both domestically and overseas.

In 1963, the company name was changed to the current "RISO KAGAKU CORPORATION." Since then, RISO has set "creating fundamentally unique products" as its development policy and released "Print Gocco B6," which took the world by storm, "RISOGRAPH," a screen printing machine, and "ComColor," a high-speed color inkjet printer, among others. Currently, RISO has three locations in Japan (Kasumigaura, Tsukuba, and Ube), as well as two in China and one in Thailand, for a total of six factories in operation. The company also has sales subsidiaries in multiple countries.

Photo 1: VALEZUS T2100

Although the company's flagship products up until now have been office-use printers, RISO's first production printer, "VALEZUS T2100" (see photo 1, hereinafter: VALEZUS) was released in 2019 on overseas markets. VALEZUS sales were also launched in Japan in March 2021. For this release, we interviewed the Domestic Sales Division Staff (photo 3) at the head office in the Tamachi Center Building (photo 2) and the Research & Development Division staff (photo 5) at the RISO R&D Center II facility (photo 4) about the characteristics of this machine, the goals of its development, and the strategy for sales in Japan based on overseas product performance.

Difficulties of ink drying in printing

The VALEZUS printer is a tandem machine which combines two of the printing engines used in the ComColor GD9630 printer (photo 6, hereinafter: ComColor GD) released by RISO in 2016 with a reverse unit, structured with connections to high-capacity paper feeding and output mechanisms and inspection units. The ComColor GD printer is capable of high-speed printing up to 160 pages per minute of simplex A4, and according to the product announcement by RISO KAGAKU CORPORATION, this was the highest printing speed of any office printer on the market at the time of its release. VALEZUS prints twice as fast, achieving 160 sheets or 320 pages of duplex A4

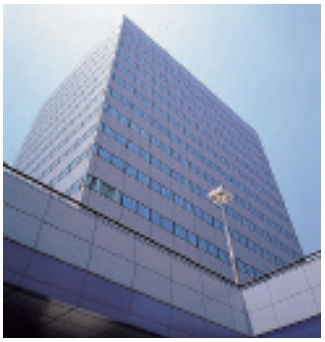

Photo 2: Exterior view of the RISO KAGAKU CORPORATION head office.

Photo 3: RISO KAGAKU CORPORATION Domestic Sales Division staff: Masanobu Tanaka (left), Takayuki Tokozume (right).

Photo 4: Exterior view of the RISO R&D Center II facility.

Photo 5: Research & Development Division staff (from the left): Ryota Yamagishi, Masanori Saito, Tomohiko Shimoda, Yukiharu Nakayama, and Naoki Iwasa. Corporate Public Relations Department: Sanae Ebizawa.

printing.

One of the distinct features of the VALEZUS printers is its use of oil-based pigment inks. RISO KAGAKU CORPORATION investigated all sorts of possibilities during the design of the ComColor GD, leveraging its knowledge of ink research and development. The result of these efforts was the development and utilization of an oil-based ink to maximize printing speed.

Unlike most of the digital machines on the market which use water-based inks, the VALEZUS uses oil-based ink, so first of all let us consider this distinctive feature. The printing quality of the current generation of water-based inkjet digital printers has improved a great deal, and there are even some machines within this group that have achieved resolution and color gamut superior to offset printing. The most difficult problem to solve for these water-based ink printers is ink drying. There is a phrase people often use to describe this point, "water-based inks are faced with two contradicting challenges." The details of these challenges are as follows.

One of the common problems that can occur during inkjet printing is clogged nozzles, which causes white lines to appear in printed materials. In order to avoid this problem, steps must be taken to ensure that the ink does not dry until after it has been sprayed out from the nozzle. However, when the water contained in this ink moistens the paper, the fibers stretch, causing it to roll, wrinkle, and curl. For this reason, the moment the ink hits the paper, it must dry as quickly as possible.

The standard method used to promote drying is applying heat with a dryer, but if the heat is too strong, this can also cause the paper to ripple. Accordingly, various companies have investigated different measures such as lengthening the paper feed distance so that the heat can be applied gradually, but these drying mechanisms also contribute to increased printer size and energy consumption, so manufacturers are all struggling to find the ideal solution. On the printing company side as well, many businesses implement their own proprietary measures in addition to the integrated drying mechanisms such as adding on special cooler units and controlling the temperature and humidity in their factories.

Similarly, at JAGAT as well, paper rippling when

Photo 6: ComColor GD9630

carrying out digital printing for book publications has been an issue. Since digital printing handles colors so well, we incorporated a large number of color papers, causing increased ink volume use and intensifying concerns about paper rippling. In the worst cases, papers could stretch after bookbinding, causing them to stick out past the cover. For this reason, the resolution was lowered, and we consulted with the printing company about paper types, thickness, and other factors, incorporating changes such as slower movement during drying and carrying out printing operations with painstaking care. Fortunately, in JAGAT's case, stable quality was maintained, however, there are also instances in which text pages stretched afterward, requiring trimming to be performed and covers to be fitted later on in the bookbinding process.

New value through oil-based ink

Compared to these water-based inks, the oil-based ink used by VALEZUS is one solution to the drying issues presented by water-based inks. Since this ink uses an oil as its base which does not stretch or deform the fibers of paper after penetrating them, there is no need to apply heat to the paper during printing. It dries by penetrating into the paper instead of being heated, similar to the drying method for inks used in newspaper printing.

Since there is no drying component of the printer, it is extremely compact overall. It provides high performance productivity in a small package. Drying components of printers use large amounts of electricity, so their elimination also saves power, and as a result the VALEZUS can operate off of a standard 100V household outlet. In addition, since no heating is used, damage to the paper during printing is low, and additional processing can be carried out on printed materials immediately, which is a major benefit.

The low cost of printing per page is also a distinctive feature. RISO only sells out printers to customers, so the main running costs for the VALEZUS are the price of ink and paper[1]. For the ComColor GD printing system used with the VALEZUS, RISO announced its in-house measurement of the cost of printing per page as approximately 0.5 yen for monocrhome and 1.44 yen for color (not including the cost of paper). With the VALEZUS, you can simply think of these figures as the cost for duplex printing. Although the cost may be higher than 1.44 yen when a large amount of ink is used, for magazines which are mostly monochrome with color used on just a portion of the pages average per page printing costs will be close to 0.5 yen[2].

When using oil-based inks, smell and effects on the human body are a concern. However, ComColor GD has thoroughly minimized the portion of volatile oils, reducing the amount of VOC emitted from printed materials to the same levels as other household printers, as shown by the eco mark certification the product has acquired[3].

Looking at the printing mechanism (photo 7), the total number of colors used is five, CMYK + GR (Cyan, Magenta, Yellow, Black + Gray). The K head is a 600 dpi resolution, so it can be used for printed text and barcodes which can be read without issue. Regrettable, the CMY + GR heads use 300 dpi resolution. If these were also 600 dpi, it would be truly groundbreaking. However, even at 300 dpi, a maximum of 12 levels of droplet size adjustment are available. It reproduces gradations skillfully with dramatically superior quality to simple 300 dpi machines.

Although oil-based inks have an advantage in terms of drying, because of the unique drying mechanism they employ, it is difficult to achieve a high optical density on the printing surface. In addition, since the ink needs to penetrate into the paper, there are some limitations such as the use of coated papers, and the feel and usability differs from water-based ink digital printers. However, RISO is using a different format to pursue the best possible balance of cost and quality with current technology, and RISO will not allow any other manufacturers do overtake them in the areas where they perform best. Even looking at the ink area alone, RISO KAGAKU CORPORATION has developed a completely different approach from other digital printers using water-based inks, showing the company's commitment to creating fundamentally unique products.

Increasing reliability with inspection units

Although VALEZUS uses a printing engine which has already been implemented in ComColor GD models, the majority of the other components were newly-designed to meet the needs production printing. The paper feeding mechanism (photo 8) is a large-capacity design which can hold up to 8,000 sheets, and since this is made up of two tiers of 4,000-sheet stacking units, paper can be refilled without stopping printing operations.

One distinctive feature of the VALEZUS printer is its paper feeding mechanism, which uses three directional air

[1] Rate structure may vary depending on the region.
[2] Costs may vary depending on the region.
[3] Certification by the Japan Environment Association

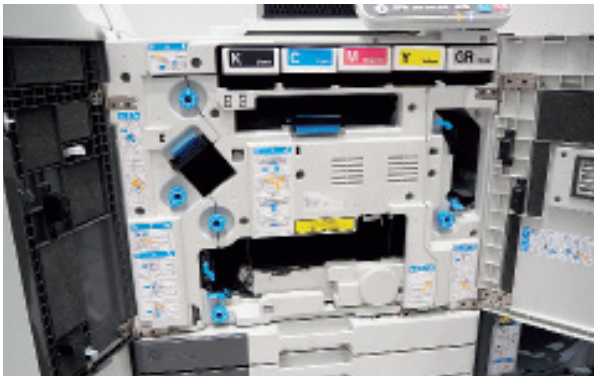

Photo 7: Printing mechanism

blowers to feed sheets one at a time (Figure 1). The initial wind is rising air that lifts up the paper, then suction air set in the upper part of the feeder grabs the paper and sends it on. Finally, the separation air is designed to prevent multiple pages from being sent stacked together. Through these three different air mechanisms, paper feeding is trouble-free even without carrying out paper handling in advance. This is unrelated, but I have heard that all new RISO employees always learn paper handling techniques. Accordingly, the majority of the company's workers know them. The designers take the techniques they learned and apply them to device functions.

Just like the paper feeding mechanism, the paper output mechanism features two connected units capable of holding up to 4,000 sheets each which can be removed without stopping printing operations. The bottom of the output unit is a hand truck design (photo 9), an innovation which makes operations easier for the workers.

There is an inspection unit placed between the printing mechanism and the output mechanism (photo 10). This inspection unit is the reason why the VALEZUS product launch was later in Japan than overseas markets. In Japan, there is an extremely high demand for quality in printing. The majority of printing companies take on contracts or others, so if there are any mistakes this can cause the loss of both trust and jobs. For this reason, RISO considered the attachment of an inspection unit to be an essential step for improving the value of the VALEZUS by increasing reliability. Accordingly, the Japanese product launch was timed based on the inspection unit development schedule.

Three different types of inspection units can be mounted on the VALEZUS: CCD cameras, CIS (Contact Image Sensor), and code readers. This enables users to individually choose the proper unit to suit the content of their business. CCD cameras read both the front and back of printed materials and use text as well as one-dimensional or two-dimensional codes to confirm consistency. CIS read the entirety of printed materials and can be used to detect smudging and missing parts through comparison with data. In addition, code readers read barcodes and two-dimensional codes and can be used to confirm front-back consistency more simply than CCD cameras[4].

Although the inspection unit was developed for the purpose of introduction to the Japanese market, since conditions are similar overseas as well, RISO is considering launching VALEZUS models with inspection units mounted in overseas markets as well if there is demand.

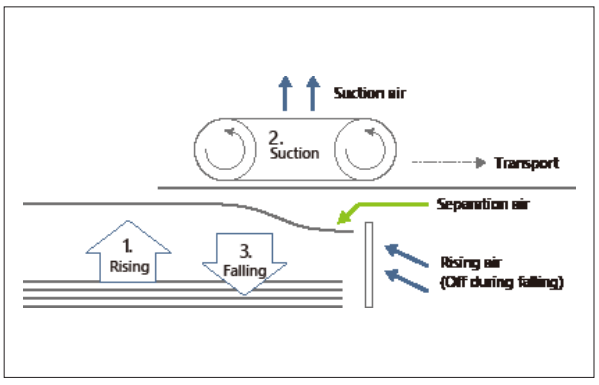

Figure 1: Air-feed mechanism

[4] These three configurations are only available in Japan. The code reader is the only option available outside of Japan.

Photo 8: Paper feeding mechanism

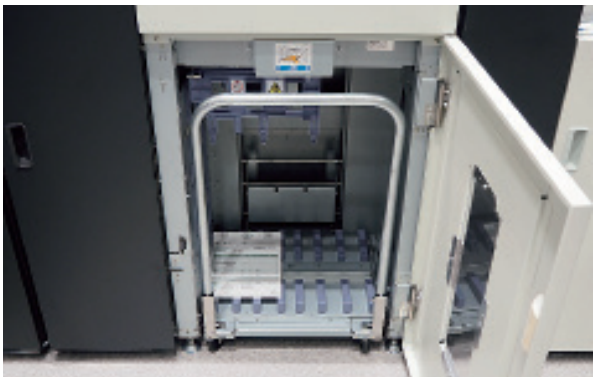

Photo 9: Paper output mechanism

Photo 10: Inspection unit

Great value created at a low cost

In the overseas markets where the VALEZUS product was launched in advance, it is mainly being used for applications such as invoices, notifications, and order forms. In the Japanese market, it is expected to be used for similar applications as a business printer model.

This may sound harsh, but the truth about invoices, notifications, and similar documents to individuals is that they are often thrown away after the recipients glance at them briefly. However, if the information printed on these materials is sufficiently understood, these printed materials have served their purpose. Not all printed materials require resolution and color gamut on the level of offset printing. In fact, aspects such as rapid printing, productivity, and reliability may actually have greater value. Printing business materials where the number of pages per minute and cost per page are relevant plays to the strengths of the VALEZUS.

In addition, if the VALEZUS can be applied to coupons, postcards, and other data printing where customer information shifts, this could greatly expand the variable printing market. For many of the types of printed materials people encounter in daily life, the information printed on these materials is more valuable than the printing quality or resolution. If variable information to suit individuals can be delivered rapidly, accurately, and at a low cost, there is great value in that. Considering this, expanded functionality such as printing onto rolls to make smoother connections to further processing stages is something we hope.

In addition, ComColor series products such as the ComColor GD and ComColor FT are useful references for considering the applicability and new value of the VALEZUS. The ComColor series was developed with the goal of making color printing more attainable, and these products achieved full-color printing at a low cost. According to RISO, there are numerous users who have shared their experience with the ComColor series, including some schools who were able to start full-color printing for materials distributed to students by introducing ComColor printers. Adding color to graphs and photos improves understanding, and in this way color printing even increased students' desire to learn. In this way, schools and related organizations are becoming one of the major purchaser groups for ComColor printers.

The introduction of full-color printing in areas where monochrome was taken for granted due to cost concerns will likely create new value in the production printing field as well. For example, if instruction manuals are printed in color, this could enable essential information to be expressed more efficiently.

The characteristics of the VALEZUS differ from digital printers which use water-based inks. Since these characteristics are prominent, the VALEZUS cannot be used for printing absolutely anything, but thinking about its applicability will also contribute to consideration of the role which the applicable printed materials are expected to fulfill. From the perspective of reconsidering the value of each type of printed material as well, introducing the VALEZUS to a business is a very interesting prospect. With its possibilities as a machine which could make extremely low-cost full-color variable printing more attainable, we look forward to seeing what kinds of experiences VALEZUS users share in the future.

(JAGAT Research and Investigation Department)

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