Optimizing the Parameters of a Maintenance Station

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Abstract

Tally has developed a new high-power inkjet printer. Two significant aims of the development were low costs per page and high-speed printout. During this project a maintenance station was designed and optimized with regard to the a. m. points. The maintenance station works with underpressure and is able to clean the nozzle plate of the piezo-printheads with a wiper, which removes the oil based ink and paper dust. A separate cover protects the maintenance station from paper debris during printing.

In order to save time and ink we examined the influence of various parameters as the amount of underpressure and the effect of sudden pressure changes on the maintenance efficiency and functional stability of the printheads. The analysis revealed reliable and less reliable areas.

Furthermore, we tried to find out how the ink consumption could be minimized during the cleaning process. In all measurements the nozzle failure was not provoked, but occurred when printing a normal print job.

As a result of our investigations we could define a working area for the printer maintenance with a high nozzle recovery efficiency an a low ink consumption.

Introduction

Inkjet heads need to be cleaned in order to remove paper dust from the nozzle plate of the head, dried ink residue or pigment deposits from the nozzles, or to remove air bubbles from the ink channels in the printhead. Service stations, which are often fitted with a masking, suction and wiping device, take over this function and are used at different intervals according to the print load. How often cleaning takes place is dependent on the number of printed pages or drawings, but the process is also initiated at least once when the printer is switched on if is not used very often.

Cleaning of the print head is frequently accompanied by a wiping process which removes the paper dust. During the cleaning process, the suction caps are positioned over the print heads and ink is sucked or expelled out of the heads by means of pressure-difference. The ink which is discharged out of the heads can be soaked up by a sponge in the suction cap and pumped out. Pressure-equalizing elements must be connected with the interior of the suction cap in order to avoid unwanted over or underpressure.

All the nozzles in the print head should be ready to operate correctly, i.e. be recovered, as soon as the correct pressure has been attained.

Once this function is available, ink consumption during the cleaning cycle can be optimized. This is particularly important when oil and solvent-based inks are being used. Because waste ink must be disposed of separately and may not be allowed to remain in the printer.

Experimental

Criteria for this optimisation are the minimisation of jet failures as well as a reduction in ink consumption during servicing. A Tally printer T3016 was employed for this test in order to recreate realistic conditions. The jet failures were initiated during printing on conventional fanfold paper. The parameters of the cleaning process should be varied by manual intervention of the operator.

This was realized using a modified hardware control system in the printer. This allowed the cleaning procedure to be initiated using PC software (HPVEE) (Figure 1).

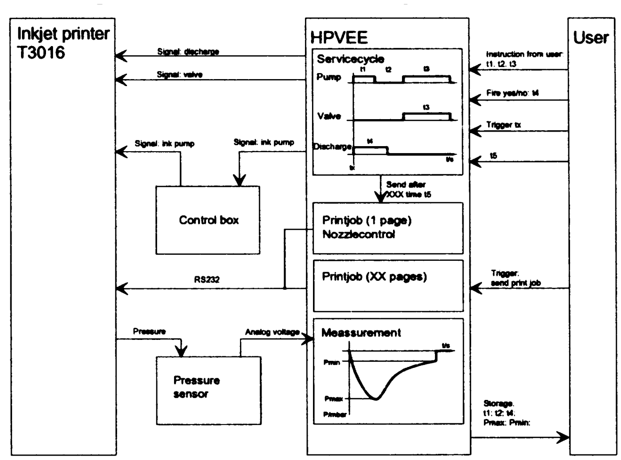

Figure 1. Schematic of the control system

The factor which can be altered in order to optimize the cleaning process is a development of underpressure in the suction cap over time. This is measured by a pressure sensor in the tubing system immediately behind the suction cap. The cap contains an ink drain connected to a hose pump and an electrically-controlled ventilation valve.

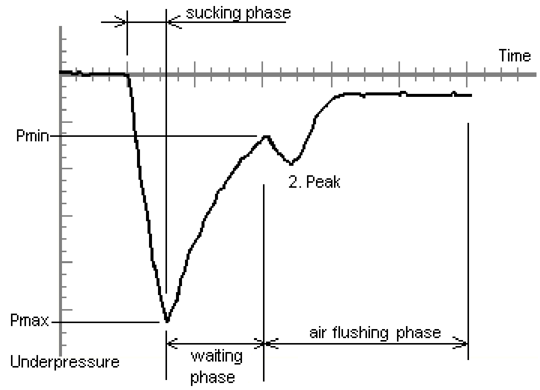

Figure 2. Typical pressure course during servicing

Figure 2 shows the principal pressure course during the execution of the service process. The following phases are the variables which influence the pressure distribution:

Suction Phase

The suction pump starts with the ventilation valve closed. Underpressure is built-up.

Waiting Phase

The pump is switched off, the valve remains closed. Underpressure sinks continuously due to the flow of ink and possible leakages.

Air Flushing Phase

The ventilation valve is opened and the suction pump starts again. The 2nd peak in the diagram shows the increase in underpressure in the hose system when the pump is in operation. The hose is separated from the suction cap by a sponge filled with ink, which must first of all be emptied before pressure equalisation takes place with the suction cap. Space restrictions mean that the pressure can only be measured in the hose.

For further processing the maximum underpressure (Pmax) and the underpressure (Pmin) at the end of the waiting phase, i.e. shortly before ventilation of the interior of the cap were selected.

Pmax and Pmin were altered in order to ensure the functional capability of the print head and to reduce the quantity of ink. The results are shown in the diagram below (Figure 3). The Z-axis shows the percentage proportion of recovered nozzles, labelled NR (100%=all failed nozzles were recovered). The mean number of failed nozzles between two service cycles was about 5. Paper dust is assumed to be the principle cause of the nozzle failures. Pmin and Pmax are shown on the X- and Y-axes. Each node of the network is created by taking three different pieces of information, consisting of NR, Pmax and Pmin. Only Pmax > Pmin > 0 are permitted.

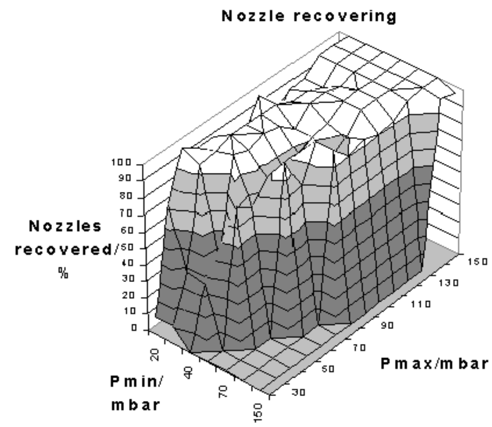

Figure 3. Nozzles recovered as a function of Pmax, Pmin

A cleaning process is defined as successful if 90% of the failed nozzles could be recovered (”NR” over 90%). It can be seen that cleansing can take place with an underpressure Pmax from 50 mbar. However, the nozzle function can only be intermittently restored by cleaning at an underpressure Pmax of up to 100 mbar in connection Pmin over 40 mbar.

The ink consumption during the cleaning process is shown in the same underpressure range Pmin and Pmax in the next diagram (Figure 4).

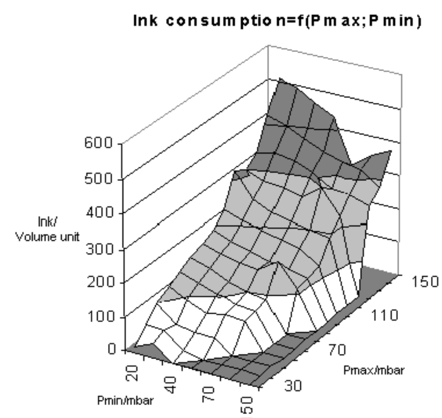

Figure 4. Ink consumption = f(Pmax, Pmin)

The ink consumption increases with increasing Pmax and decreasing Pmin. From the comparison of both diagrams it is evident that the service success becomes acceptable at a minimum ink volume of about 110 volume units.

The Selection Criteria for Pmax and Pmin Are:

Pmin as low as possible to avoid pressure jumps in the system and Pmax as low as possible to keep the ink consumption low during service.

For the combination under test with maintenance station / printhead / ink combination we defined Pmax at 80mbar and Pmin at 20mbar. The ink consumption related to the above values is about 70µl per head.

Conclusion

The working parameters of the maintenance station with respect to low ink consumption and moderate pressure variations have been optimized. Further investigation may show, how pressure purging and nozzle fire could even further improve the functional stability of the printer.

Biography

Th. Franke has been working as a design engineer at Tally Computerprinter / Germany since September 1996. His area of responsibility includes the dimensioning and designing of the maintenance station of the new inkjet printer. Mr. Franke is author of several patents applications in the field of inkjet technology.
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