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Harshwardhan Gupta's Design Tips–7

Pneumatic Systems

Compressed air is a VERY expensive commodity. If improperly designed and built, a pneumatic system can prove to be the most expensive thing to run. Two things contribute to this most invisible of all wastes: Leakages, and improper practices. Lets tackle both.

Hisses and silent leaks: Many factory owners do not know that a faint hiss or even a cool-feeling "just-little-bit-only" air leak from a compressed-air system is quietly costing them hundreds of rupees a day. In a big factory, this can go into thousands of rupees a day. An air leak does not drip, so no one notices it.

So, if you want to save money, first stop those leaks! Really, really stop each one of them.

1. To do that, listen for leaks when it is absolutely quiet around, after the factory has shut down or when the power goes off (have the line pressure on, obviously). Then, go around the whole pneumatic system, feeling for leaks with your hands and fingers. Spots of oil (in lubricated-air systems) around a joint usually mean a faint leak. Detection by hand is easy but exact pinpointing may be tricky, as leaking air behaves in strange ways around fittings and around piping. A solution of bathing soap (not detergents – they corrode zinc-plated parts very fast) and glycerin can help pinpoint the leak. Be careful not to let this solution seep into the electricals, or the treatment will prove worse than the disease.
2. Fix the leaks in a professional, scientific way, not like a roadside mechanic. If the sealing ring is damaged, replace it instead of using Teflon tape. Teflon tape in pneumatic fittings is generally a bad idea; as not only it suppresses leak noise, but often tiny shreds of the tape find their way into valves, pilot circuits, etc. and cause days and weeks of investigative downtime. The sealing rings, or sealant-covered threads, which come with fittings, do their job well. If both are absent, use anaerobic thread sealants of a good make.
3. Replace / repair / rebuild leaking valves, cylinders and other hardware as soon as possible. A fitting or a leaking length of tube will waste air worth its cost within ONE DAY!

Faulty Practices: Air wastage due to bad assembly is something no machine-builder wants to admit. Poor user suffers in silence since he does not know what to complain about. So lets have a proverbial 20-point programme:

1. Lower the compressor switch-off pressure: 10 bars seem to be the norm for a 6 bar final pressure. This is wasteful. You are first compressing the air excessively, and then letting it expand in the pressure regulator. To achieve what? Set the compressor on 7 bars on and 8 to 8.5 bars off and you will save 10% energy straightaway. Regularly drain the air tank of the compressor. A 100-liter tank used continuously can fill up completely with water in 1 week in rainy season.
2. Filter the incoming air well, and keep draining the accumulated condensate. Oxidized oil-mist carried from the compressor + condensate make a very corrosive, abrasive and sticky mixture. This cannot be filtered by the usual 40μ filters. Go by ISO-8573-1 recommendations.
3. Mount the FRL unit in FRONT of the machine where it can always be seen, and serviced regularly. Out of sight is out of mind.
4. If you have long air lines in the factory, have enough and proper water traps all along, and keep draining them.
5. Use 1-to-2 pressure boosters if you need high-pressure air for a few cylinders, instead of overloading the compressor and the whole system.
6. Use pressure switches to switch off the machines when air pressure drops. Low

pressure can cause freak accidents more easily than you think.

7. Always use filtering silencers in the exhausts to prevent lube oil mist making the breathing air toxic.

8. Do not attempt to clean filters. Replace them after the pressure drop across them becomes more than 1 bar.

9. Lubricated or dry air? The latter is getting more popular now. If you use a lubricator, 2 to 8 drops per 1000 liters of free air is sufficient. If your system uses, say, 100 LPM of air, then you need one drop every 3 *minutes*! I have seen people set the lubricator at 10 to 100 times that rate. This excess leads to oil accumulation in cylinder ends and valve chambers, and leads to inexplicable failures, besides making everything dirty with sticky oxidized oil spewing everywhere. If you use dry air, make sure the dryer is always in good shape. You should NOT lubricate dry air. Nor should you use "wet" air without lubrication. I personally prefer dry air systems.

10. Normal Bourdon-type pressure gauges are notoriously inaccurate and damage-prone. So if you suspect that your system is running on too low or too high pressure and the gauge is showing right pressure, then try replacing the gauge first.

11. Air tanks should be put AFTER the FRL, not before. And put a non-return and shut-off + exhausting valve between the tank and the FRL. If you try and exhaust a system through the regulator itself, you will end up rupturing its diaphragm.

12. Use smallest bore cylinders for a given job. Use smallest bore pipes to feed them adequately. For example, If a 40mm dia cylinder can do the job and 3mm pipes can run it fast enough, don't use a 63mm dia cylinder fed with 8mm pipes with two fat flow-control valves trying to choke the exhaust to slow the runaway cylinder down. You are just wasting capital cost AND running cost. However, feed the *valves* with fat pipes (and put thin pipes between the valve and the cylinder, as I said), so you don't starve the cylinder of air.

13. If a cylinder is only doing a momentary job – like printing a batch-code, or punching a small hole, reverse the cylinder as soon as it has reached its forward position. If you dwell in the forward position, you will end up fully pressurizing the cylinder before exhausting it just milliseconds later. That way you consume more air. Please understand that in a majority of cases, a pneumatic cylinder achieves full pressure *a little while after* it has reached the end.

14. To economize on air, don't use a double-acting cylinder if a single acting equivalent can do the job.

15. Do not use cylinders as guides, except when the sideways loads are nil or virtually nil. Even a moderate side load will wear the cylinder end out in a few months.

16. Venturi-based vacuum-generators guzzle air at a phenomenal rate. Weigh the pros and cons before choosing between them and a vacuum pump.

17. Achieve appropriate cylinder velocity and noise by a judicious use of end-cushion adjustment, flow-control valves and shock absorbers. For the best and fastest performance, you will need all three devices.

18. Do not let pistons batter into the cylinder ends. If you hear even a moderate hitting noise, fix it, else you will have a catastrophic failure soon, when you least expect it.

19. In pneumatic systems, as in life, one who buys expensive stuff gripes only once; one who buys cheap stuff weeps *baar-baar*.

20. Last but not the least; DO NOT fool around with compressed air jets closely playing on any part of the human body. High-pressure air can very easily diffuse into the blood stream and can take a life, yes, it can kill even before someone has a chance to dial for the ambulance.

Leaking and wasted air means leaking and wasted profits. Save air and hence save money.

Kya zamana aa gaya hai, aajkal hawa bhi muft nahin hai!

Next Month: Saving on Energy

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