LECTURE 36 – CONDITIONING AND DISTRIBUTION OF COMPRESSED AIR

SELF EVALUATION QUESTIONS AND ANSWERS

Problem 1:

Refer to the relevant air consumption chart and compressor specification chart, select a suitable compressor for a machine tool workshop having the following air tools

Item no	Air tools	Quantity	Working pressure (bar)(absolute)	Utilization factor
1	Cylinder (70 mm)	5	6	0.3
2	Spray gun(1.3mm)	4	5	0.3
3	Air screw driver(5mmPT)	2	6	0.2

Problem 2:

In machine shop, there are four numbers of compressors installed for compressed air requirement. All the four will be in operation at any point of time. The rated capacities of compressors are 2.84 m3/minute, whereas the actual output of each are given below

Compressor 1	2.17 m^3/min
Compressor 2	2.23 m^3/min
Compressor 3	2.75m^3/min
Compressor 4	2.50 m^3/min

The power consumption of these compressors is 29kW, 27Kw, 22 and 25 kW The compressor is continuously operated at 7 bar pressure. During the measurement it was observed that the leakage losses constitute around 45% of the actual output of the compressor. Estimate the following

a) **Power loss due to leakage**

b) **The power saving if 50% of leakages are arrested**

Note that the compressors have on and off control

Q1 Solution

Let us first calculate the total demand

Item no	Air tools	Quantity	Working pressure (bar)(absolute)	Utilization factor	Air demand LPM	Air demand at STD @9bar	Total air demand
		A		**C**		**B**	**A×B×C**
1	Cylinder (70 mm)	5	6	0.3	4.6	3.5	5×3.5×0.3=5.2
2	Spray gun(1.3mm)	4	5	0.3	50.9	31.8	4×31.8×0.3=38.2
3	Air screw driver(5mmPT)	2	6	0.2	250	187.5	2× 187.5 ×0.2=75
							Total demand = 118.4 LPM @9 bar

Step 1: Standard pressure (STD) = 6+2 = 8 bar

Step2: Find the air demand at STD pressure

$$\frac{p_1 Q_1}{T_1} = \frac{p_2\ Q_2}{T_2}$$

$$6 \times 4.6 = 8 \times V_2$$

$$Q_2 = 3.5 \text{ LPM}$$

To find Q3 at FAD (at FAD, P2 = 1bar)

$$\frac{p_2\ Q_2}{T_1} = \frac{p_3\ \ Q_3}{T_2}$$

$$p_2\ Q_2 = p_3\ \ Q_3$$

$$8 \times 118.4 = 1 \times Q_3$$

Therefore $Q_3 = 947.2$ LPM @ 1 bar

From the compressor specification chart, the selected compressor is as follows

Model Number	M6
Power	11 kW
Working pressure	12 bar
Compressor speed	710 RPM
Tank capacity	283 Liter

Q2 Solution

Part a

Output of all four compressors

2.17+2.23+2.75+2.50= 9.65 m^3/min

Power consumed by the compressor

29+27+22+25 = 103 kW

Specific power consumption = $\frac{103}{9.65} = 10.68\ kW/(\frac{m^3}{\text{min}})$

Leakage quantity = 45 % of the actual output = 0.45 × 9.65 = 4.3425 m^3/min

Equivalent power loss = 10.68 × 4.3425= 46.4 kW

Part b

If 50% leakages are arrested that is = $\frac{4.3425 \times 0.5\ \text{m}^3}{\text{min}} = 2.1713\ \text{m}^3/\text{min}$, power loss is 46.4× 0.5 = 23.2 kW

Hence power saving is 23.2 kW