Awareness Workshop on Energy Efficient Japanese Technologies and Best Practices in Compressed Air System

11th November, 2014 at Pune

Organised by

The Energy and Resources Institute (TERI)
Institute for Global Environmental Strategies (IGES)
Maharashtra Energy Development Agency (MEDA)

Workshop summary

An awareness workshop on ‘Energy Efficient Japanese Technologies and Best Practices in Compressed Air System’ was organised on 11th October 2014, at Courtyard Marriott, Pune by TERI and Institute for Global Environmental Strategies (IGES), Japan in collaboration with Maharashtra Energy Development Agency (MEDA). About 45 participants from government, industry, consultancy agencies and donor organisations attended the event. A summary of the deliberations at the workshop is presented below.

Mr Chetankumar Sangole, TERI welcomed the Japanese compressed air experts and other delegates to the event. He also gave an overview of the activities being undertaken by TERI and IGES to disseminate Japanese energy efficient technologies among industry in India.

Mr Hemant Patil, MEDA gave the inaugural address. He mentioned that Japan is well known for energy efficient technologies and hence such bilateral cooperation will be of great mutual benefit. MEDA provides support for energy audit studies and also gives financial assistance for implementation of energy efficiency projects. He urged the units to conduct energy audits and take the help of organisations like TERI for energy efficiency improvements.

Mr Prosanto Pal, TERI gave an overview of the proposed bilateral ‘Joint Crediting Mechanism (JCM)’, between India and Japan and mentioned that the mechanism would provide a good opportunity for financing of new energy efficient Japanese technologies for adoption in India. He also mentioned about TERI’s activities among forging units in Pune cluster under the World Bank-GEF program.

Dr Rabhi Abdessalem, IGES made a presentation on the ALCT project, undertaken by IGES and TERI with support from JICA/JST. Under the project, hard technologies like Gas Heat Pump (GHP) and Electric Heat Pump (EHP) and soft technologies in compressed air and induction furnaces were demonstrated among SMEs in India. In future, the JCM scheme can be used to implement low carbon Japanese technologies in India and support under Climate Technology Centre and Network (CTCN) of UNFCCC can also be explored.

Mr Tsukasa Saito, Hitachi Industrial Equipment System, Japan made a presentation on ‘Best Practices in Compressed Air Systems’. He mentioned that the air compressor consumes between 20-40% of the total energy in many industries. Typically, in an air compressor’s life cycle, cost of operation (energy) is 84%, capital cost is 7% and maintenance cost is 9%. He highlighted the need to reduce the consumption of compressed air and reduce the compressed air generation pressure wherever possible before optimizing the air compressor itself. He emphasised various areas which are important for efficient operation of air compressors such as pipe sizing, reducing unloading time, reducing the use of valves, epoxy coating of air receiver, providing drain valves, proper sizing of filter and air dryer, closed loop system, use of two stage compressor, use of invertor compressor, proper sizing of air receiver, use of exhaust ventilation ducts, use of nozzles and many such measures.

ANNEXURES

Annexure 1: Agenda of the event

Awareness Workshop
Energy efficient Japanese technologies and best practices in Compressed Air System

Venue:
Courtyard Marriott, Pune

Date:
October 11, 2014 (Duration: 9:30 am – 3:00 pm)

Tentative Agenda

09:30 – 10:30 am	**Registration & Tea**	
10:30 – 10:45 am	**Welcome Address**	**Mr. Chetankumar Sangole,** The Energy and Resources Institute (TERI), India
10:45 – 11:15 am	**Overview of TERI-IGES Project**	**Mr. Prosanto Pal,** The Energy and Resources Institute (TERI), India **Dr Abdessalem RABHI,** Institute for Global Environmental Strategies (IGES), Japan
11:15 – 11:25 am	**Inaugural Remarks**	**Mr. Hemant H Patil,** Manager, Environmental & Energy Efficiency, Maharashtra Energy Development Agency (MEDA), India
11:25 – 13:00 pm	**'Energy efficiency in Compressed Air System' – Japanese Experience**	**Mr. Tsukasa SAITO,** Senior Engineer, Air Compressor System Division, Hitachi Industrial Equipment System Co. Ltd, Japan
13:00 – 13:25 pm	**Discussion/Q & A**	
13:25 – 13:30 pm	**Vote of Thanks**	**Mr. Kailash Tarde,** The Energy and Resources Institute (TERI), India
13:30 pm	**Lunch**	

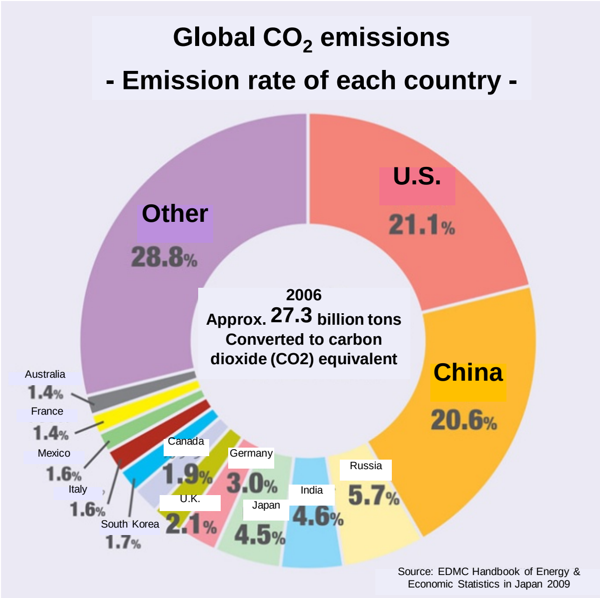
Annexure 2: Energy saving and environmentally friendliness of air compressors

2014 VERSION

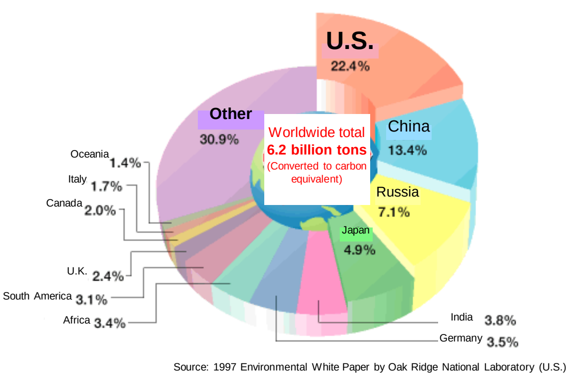
Energy Saving and Environmentally Friendliness of Air Compressors

Hitachi Industrial Equipment Systems Co., Ltd.

Trends in Global CO2 Emissions



2006 figures

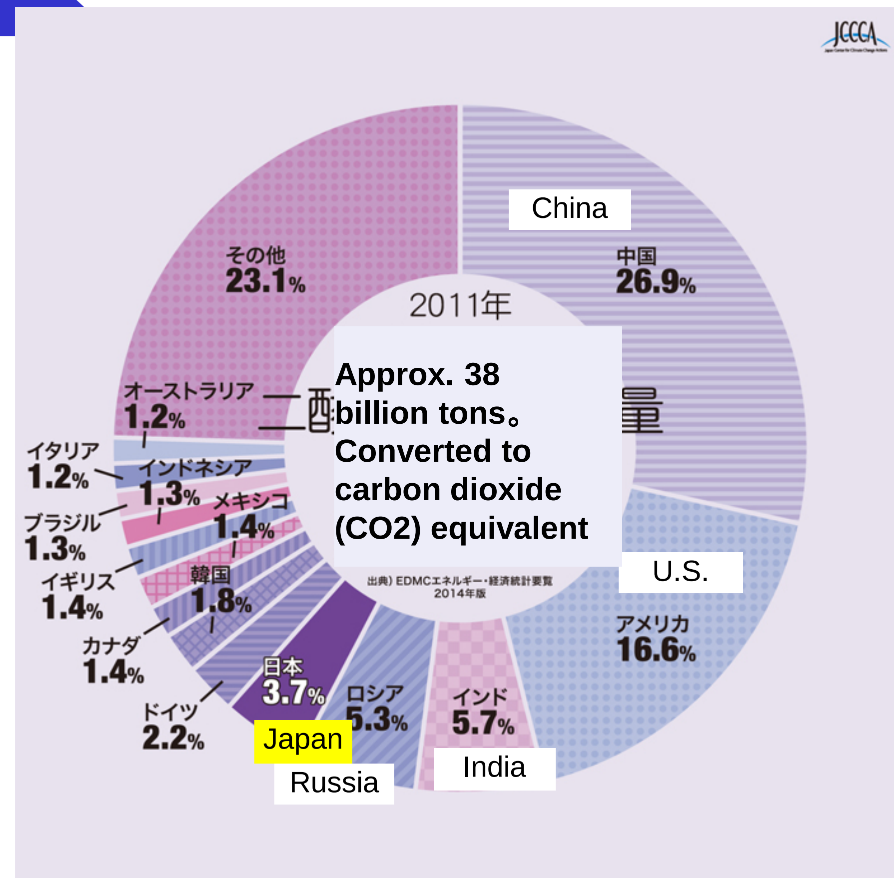


1997 figures

100 million tons

China	8,561
US	5,271
India	1,801
Russian	1,677
Japan	1,174

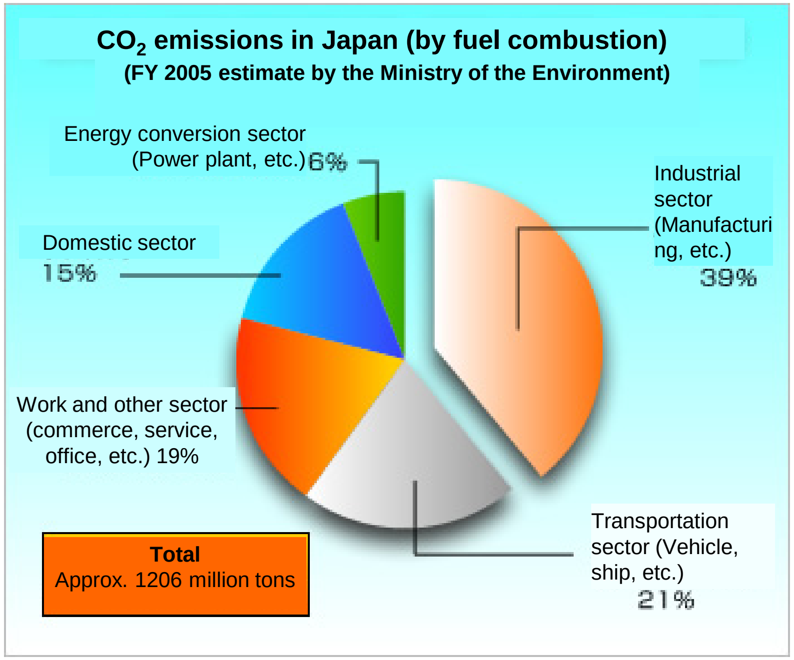
38 billion tons worldwide

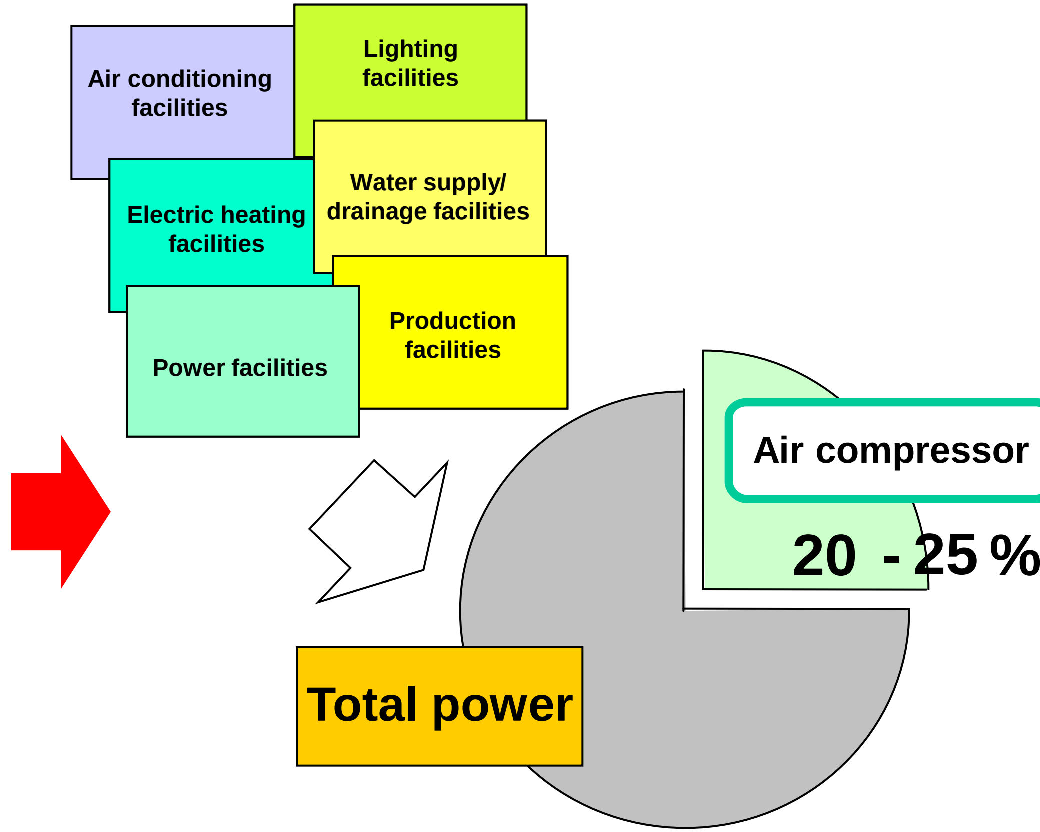


Published by International Energy Agency (IEA)

2011 figures

Energy Consumption in Japan





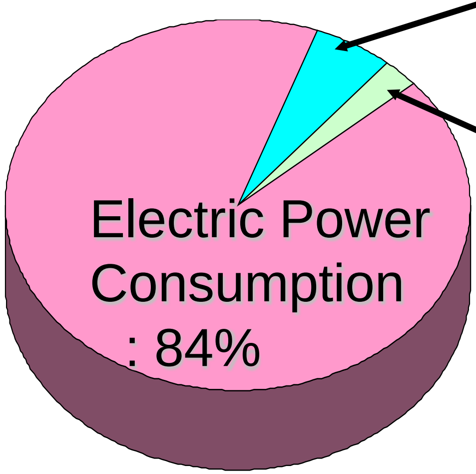
Energy consumed for the industrial sector (factories) accounts for approximately 40% of the total energy consumption in Japan.
It is considered that approximately a quarter of that amount is used by compressors.
In addition, compressors are regarded as machines whose energy consumption can be reduced relatively easily. As a result, energy saving through rotation control and multiple unit control is strongly requested by the Ministry of Economy, Trade and Industry as well.
Therefore energy saving for compressors needs to be addressed urgently.

Let's check out energy cost -LCC and Specific Power Consumption

Most of compressor LCC is power consumption.

Note: LCC = Life Cycle Cost

<Example>
Oil flooded 75kW class rotary screw (Hitachi)
6000hr/y operation ¥17/kWh
100%Load example
Total cost: 12 years average



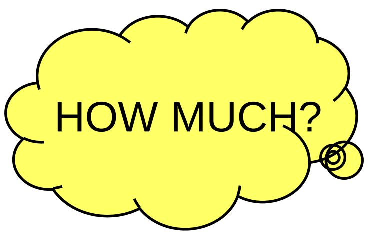
Maintenance: 9%
Carry out periodical maintenance.

Initial: 7%
(compressor, installation/starting, piping, etc.)
Select better efficiency, better control.

If average air consumption decreased by 70%, electricity cost decreased by 70%.

Specific Energy Consumption

How much to for 1 m³ of compressed air? --- Example of quick calculation



$$\text{Energy cost } (¥/\text{m}^3) = \frac{\text{Power input (kWh)} \times \text{Electricity cost (¥/kWh)}}{\text{FAD } (\text{m}^3/\text{min}) \times 60 \text{ (min)}}$$

Key points of energy saving for compressor equipment

Flow of pneumatic system improvement

1. Reduce the consumption.

Reduce unnecessary air consumption of equipment to lower the compressor's load factor.

Stop the compressor.

Reduce air leakage.

3 biggest points for energy saving of pneumatic system

3. Optimize the compressor system.

Utilize inverter compressors.

Optimize operating pressure.

Select an appropriate model.

Appropriate maintenance

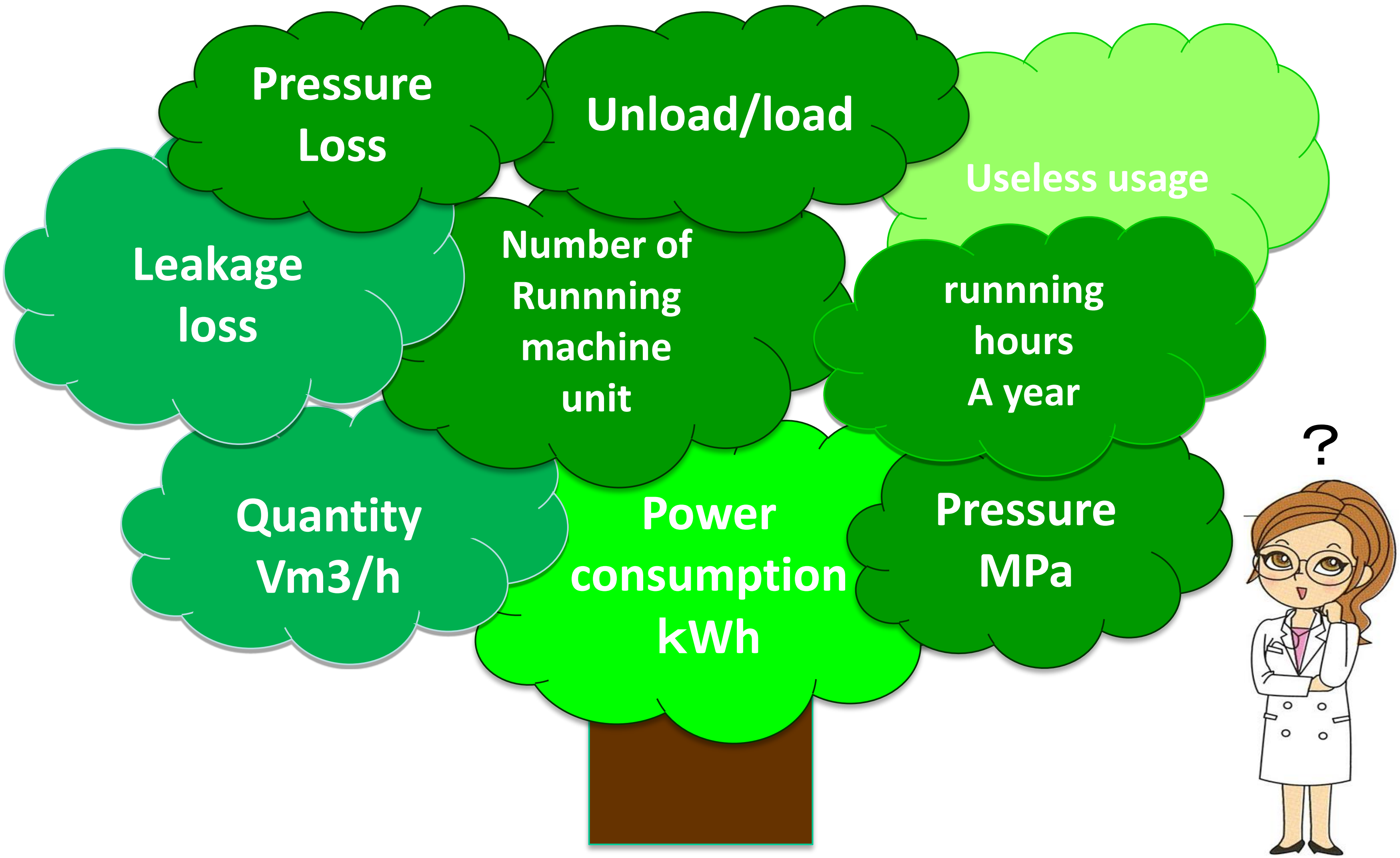
2. Reduce operating pressure.

Review and reduce pressure required for the equipment.

Divide compressors based on required pressure.

Reduce pressure loss.

What is cost of air compressor?



CO_2 reduction=energy saving of the air system

Saving energy of compressed air system＝Energy cost down

Energy cost (L kW)= pressure (P) x air consumption(V)

The policy for cost cuts useless

- Lower useless pressure (P)
- Reducing volume air consumption (V)
- Improvement (pressure loss, leak) of the loss

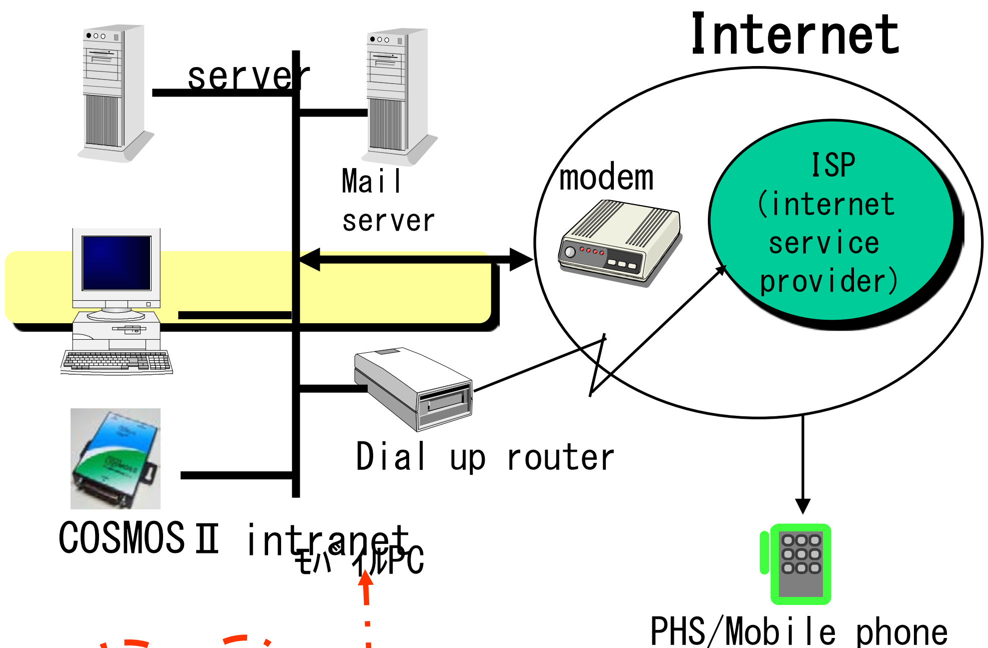
The point of the energy saving is to get rid of waste how, and to perform the following

1. Making better capacity control (use the efficient machine)
2. Make efficient use of equipment
3. Appropriate pipe diameter and length=down compressed air speed
4. Counter measurement of leak

Remote Monitoring System (COSMOS Ⅱ)

Easy monitoring on PC utilizing LAN (Local Area Network).
Easy communication with Service department.
Social needs for the remote monitoring is increasing together with Electric power monitoring.

LAN environment



COSMOS Ⅱ has mail-send function for Warning/shutdown.
(NOTE: for this function, it is Necessary to install mail server or open an account of IPS (internet service provider).

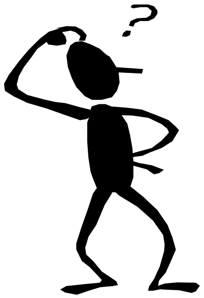
Other monitoring system with WEB controller remote monitoring service for important equipment is also available.
Latest technique enable on-time insulation monitoring as well.

In this practice, we verify the importance of proper pressures design at positions in air supply lines.

1. Piping system
   How pressure loss changes if size changed?
   How pressure loss changes if valve structure differs?

2. Air compressor
   How input power changes if compressor is driven by Inverter?
   How pressure fluctuation changes if air tank is installed.

3. Local pressurization
   What is “booster babicon”?

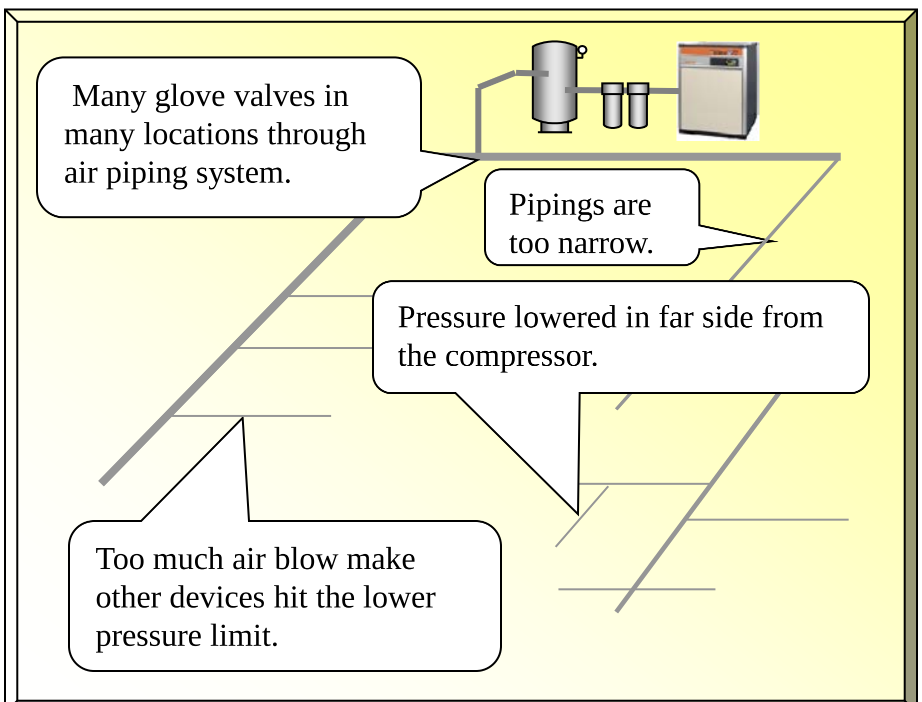


1. Pressure optimization by piping system redesign.

What is efficient way for local low pressure demand.
Do you have similar cases like this in your factory?

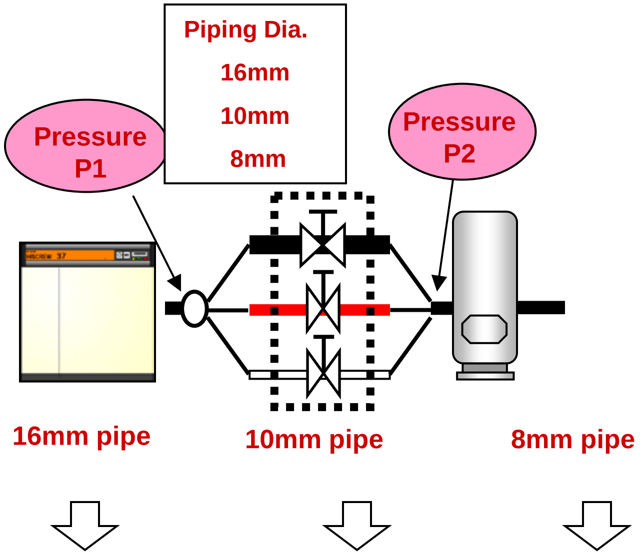
1. **Unstabilized factory air.**
   [status] **pressure far side from compressor unstable.**
   Pressure down when other system ON.
2. **Due to budget allowance, no uniformity on air system such as devices, pipings (size, route, valves).**

What kind of improvement in this case?

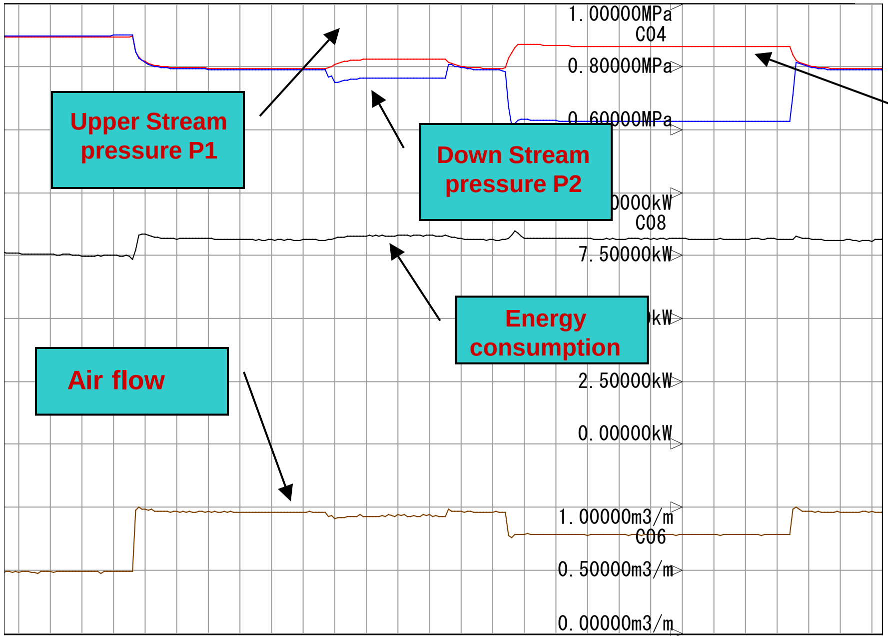


How loop piping, size, bend and valves effect proper pressure in system?

Discharge pipe diameter and pressure loss



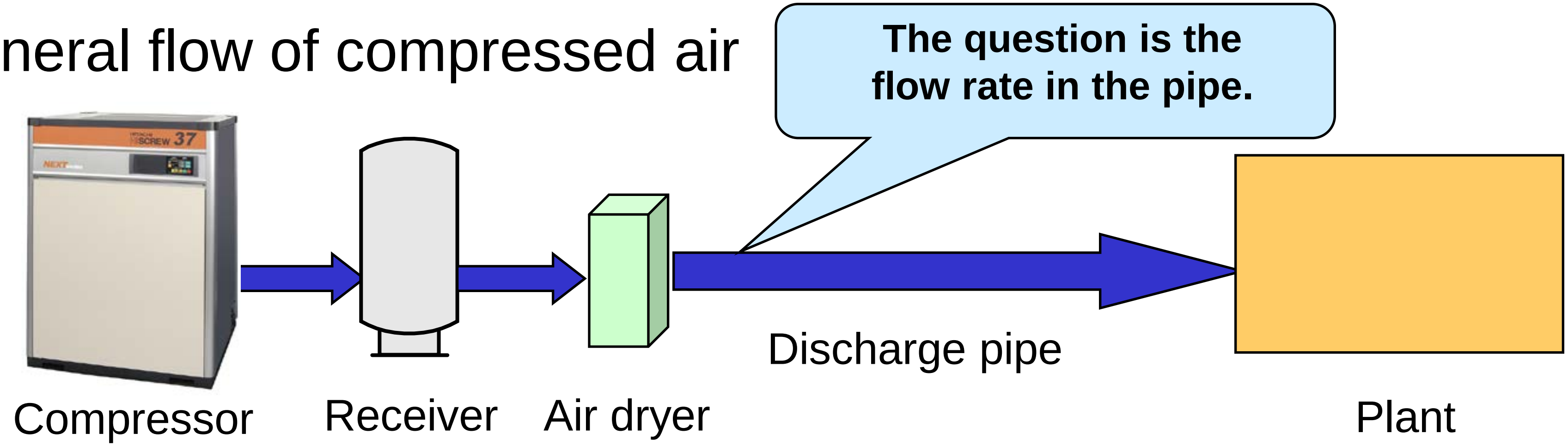
How much difference if piping diameter is changed?



In case piping diameter is 8mm, upper stream pressure is increased because pressure loss is big.
As a result, air compressor commands unload operation.
Therefore, bottom stream pressure is much decreased.

Pressure Loss through Pipe and Internal Flow Rate

General flow of compressed air



$$\text{Flow rate in the pipe. } V\ (\text{m/s}) = \frac{\textbf{Qs}\ \text{Compressor's discharge air volume} \times \text{Ps/Pd}}{\textbf{A}\ \text{Sectional area of discharge pipe} \times 60}$$

The flow rate in the pipe is desirably 4 to 5 m/s. - Economic speed

The smaller the pipe size, the higher the flow rate, causing a larger loss in the pipe. Accordingly an energy loss is generated, reducing the energy-saving effect.

* Example of 75-kW HISCREW NEXT (Discharge pressure: 0.69 MPa, discharge air volume: 13.2 M3/min), size of discharge air pipe: 50mm

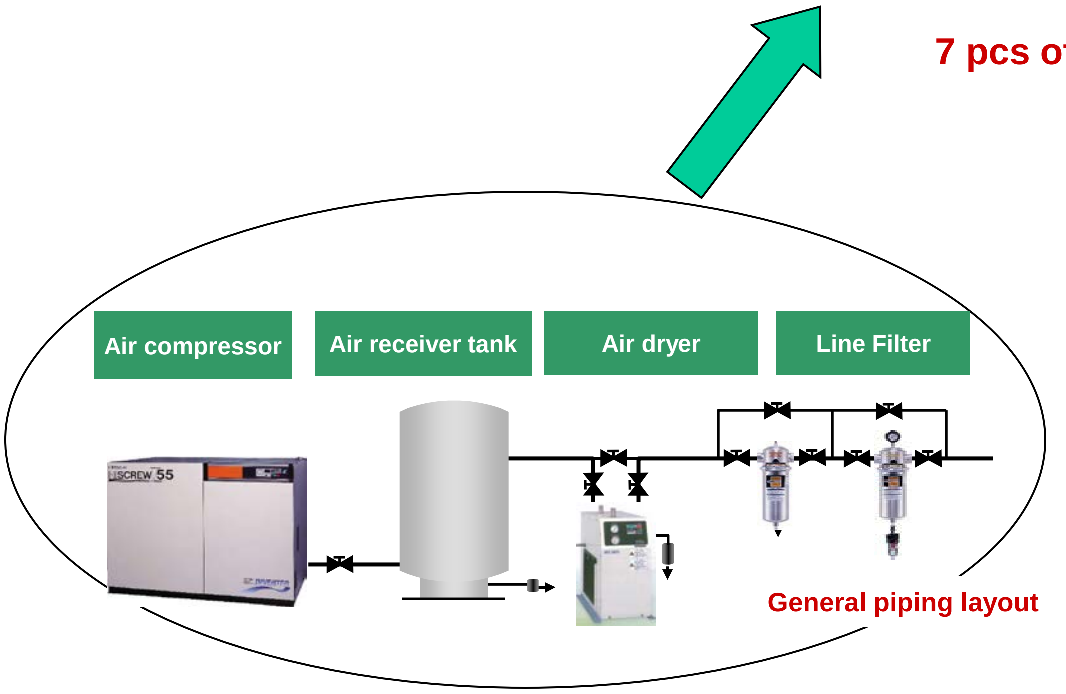
$V = 13.2 \times 0.101 / (0.101 + 0.69) \div 0.05 \div 0.05 \div 3.14 / 4 \div 60$

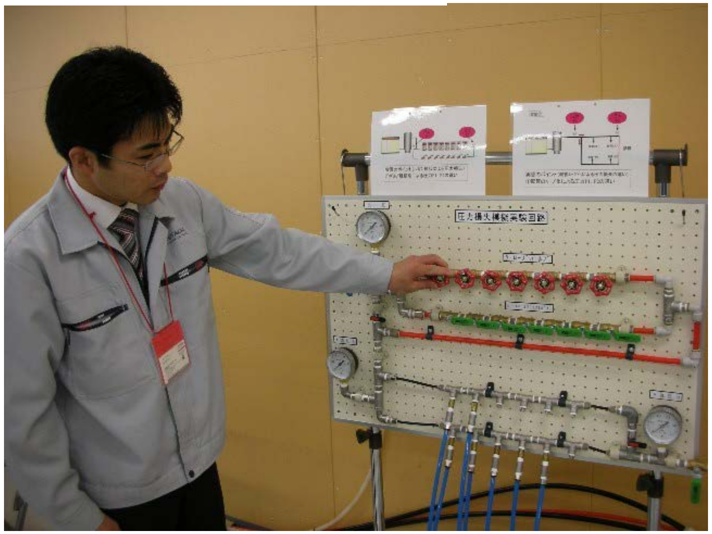
$= 14.31$ m/sec (This is a very high speed.) The energy-saving effect is low.

Pressure loss depends on valve types and shapes

Big loss····

7 pcs of glove valve(*** Valve)





Pressure loss caused by different types of valve

Contents of Improvement Measures - Examination of Piping Work

Example of pipes having many valves or bends. All of these generate resistance, causing pressure loss.
Change the type of the valves (to the one with low resistance) or reduce bends as much as possible.

A pipe narrowed immediately after the air dryer. Generates resistance, causing pressure loss.
A riser pipe. Causes a backward flow of condensate, leading to an increasing number of mechanical troubles.

Examples of problematic piping

Drain trap attached just behind the compressor.
Clogging of the pipe may be caused.
Also, it increases the resistance at the immediate back of the compressor, which not only causes energy loss but also makes control difficult.

Rust of receiver tank and internal corrosion may be caused.
Internal resistance increases.
It is recommended that a receiver tank with internal treatment with epoxy or similar be selected.

Rubber hose connected from the compressor to the discharge pipe.
It causes a large internal resistance and is inappropriate in terms of energy saving.
Rubber hoses generate resistance higher by 20% or more than steel pipes and are not inappropriate.

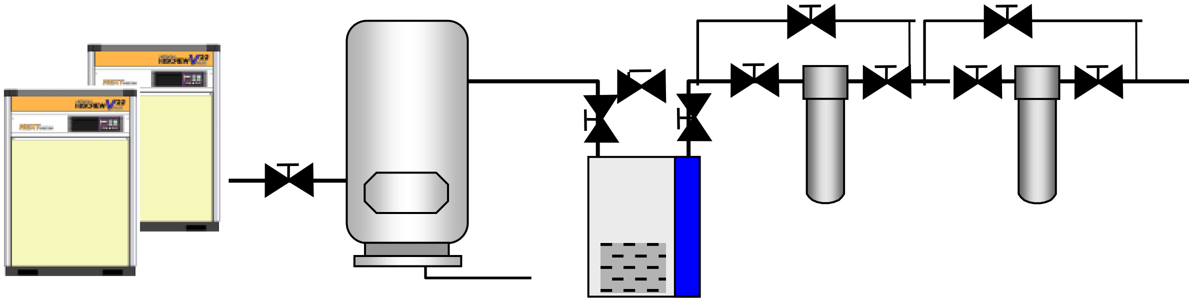
Examples of recommended piping

Provide a drain plug for a riser pipe.

Recommended collecting pipe

Riser pipe installed from above

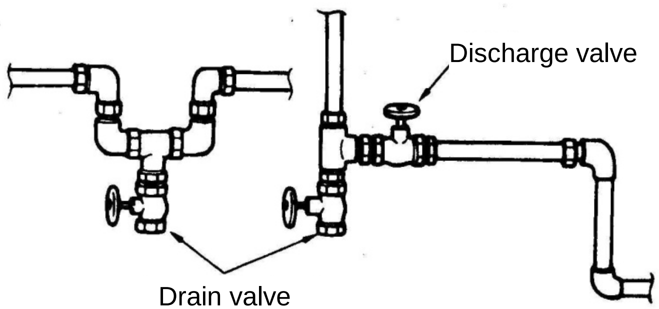
Large-bore pipe and receiver tank with adequate capacity

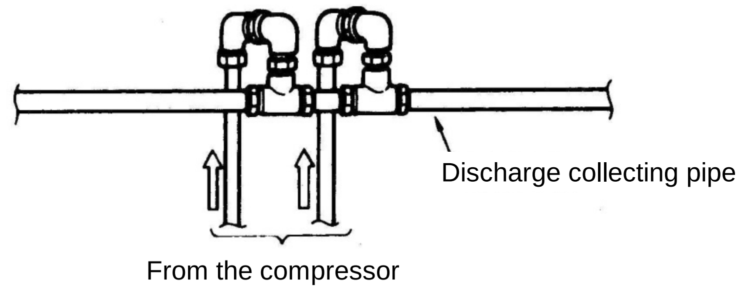


Recommended equipment and pipe flow

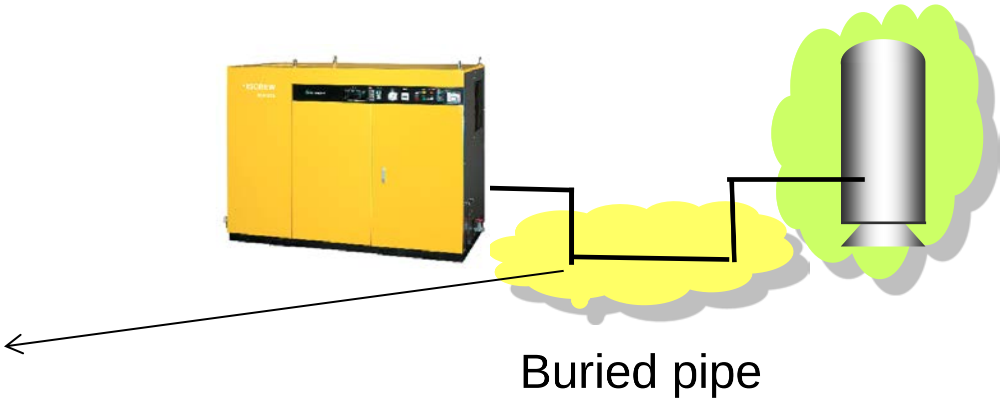
Notes for Piping Work

1. **Be sure to provide a drain connection for a riser pipe. Installation to a collecting pipe must be made from above to prevent backflow. (Similarly, branch pipes must be installed from above.)**
2. **For a collecting pipe, give an inclination (1/100) from the upstream to the downstream. Attach a drain plug at the end of each pipe.**





3. **Buried piping makes it difficult not only to detect air leakage but also to repair. Therefore above-ground piping must be adopted. If buried piping is inevitable, install the pipes in a pit.**



Reduce internal pipe resistance for energy saving

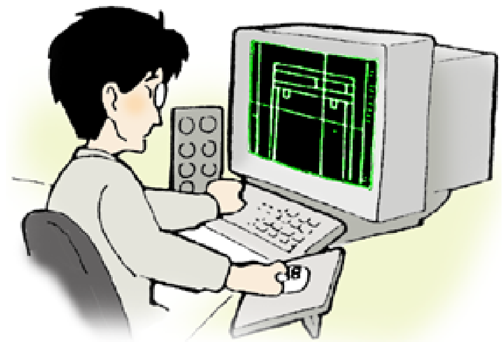
Example of piping improvement

Review this piping !! Easy for energy saving!!

Narrow piping

Complicated piping

Many partition piping



Energy saving effect 11%

405,000kwh => 360,450kwh (improvement)

OSP-75D5ALI

Piping diameter 2B => 3B

Size up capacity for air dryer

Size up for air filter

Replacement, construction fee: 3,000k¥

Investment recovered：4.5year

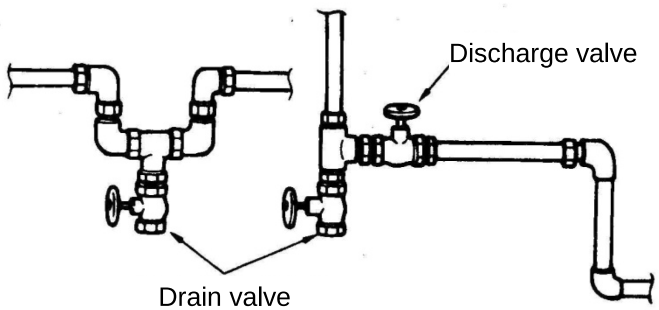
Pressure loss:

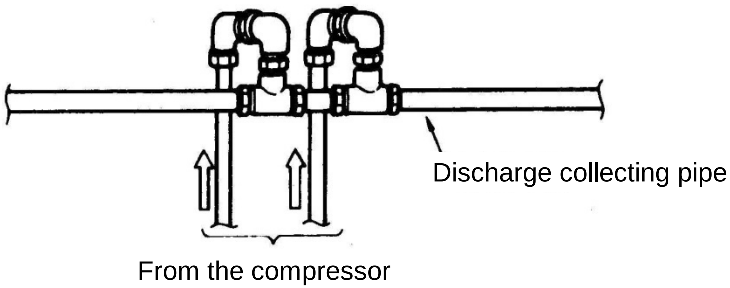
0.2MPa => 0.5MPa (improvement)

Notes for Piping Work

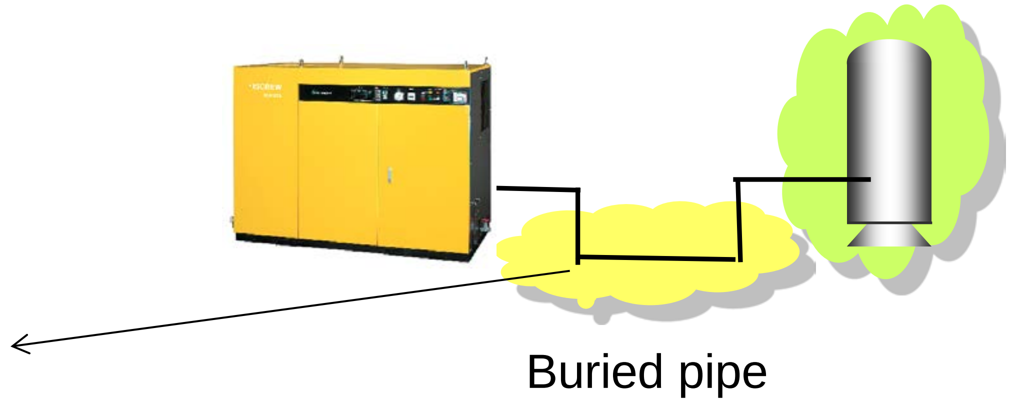
1. **Be sure to provide a drain connection for a riser pipe.**
   Installation to a collecting pipe must be made from above to prevent backflow. (Similarly, branch pipes must be installed from above.)

2. **For a collecting pipe, give an inclination (1/100) from the upstream to the downstream. Attach a drain plug at the end of each pipe.**

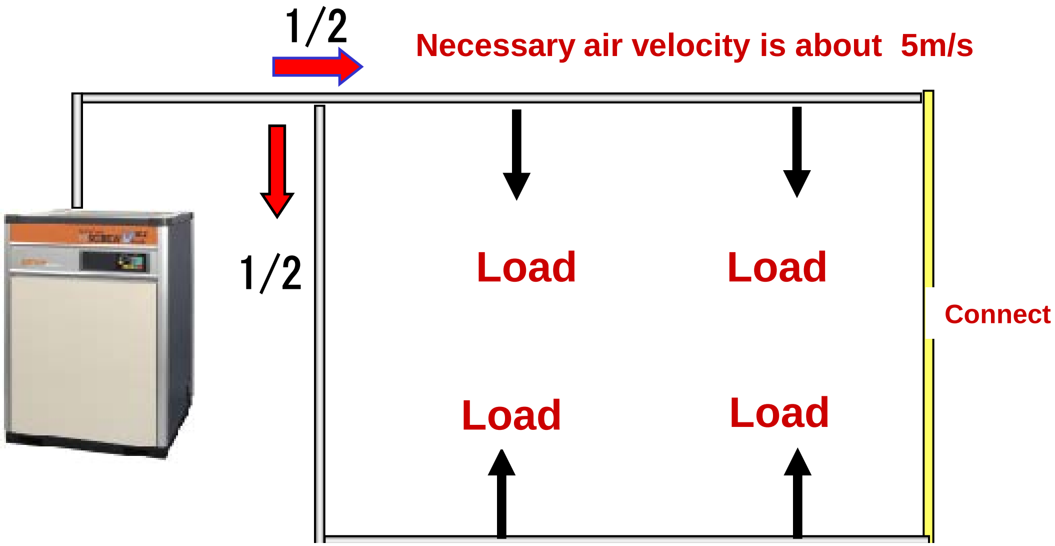


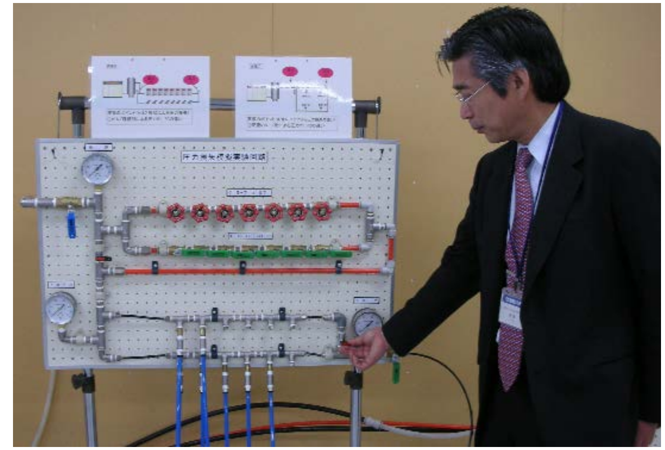


3. **Buried piping makes it difficult not only to detect air leakage but also to repair. Therefore above-ground piping must be adopted. If buried piping is inevitable, install the pipes in a pit.**



Changing air velocity through internal pipe ･･･ loop piping





Pressure loss is two times higher of air velocity in proportion

How much improvement can be made with loop piping?

Pressure loss is minimized to one quarter, only to make loop piping!

Pressure loss become one quarter, only to make loop piping if there is imbalance among load.

Improvement with air compressor and air receiver tank

Ideal and effective operation by variable speed control compressor with air receiver tank

Do you have any familiar situation like below?

There are many possibilities to reduce extra power by changing into air compressor’s control operation with air receiver tank.

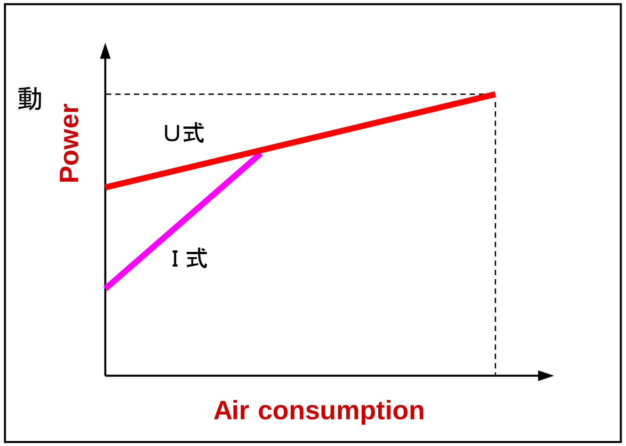
1.Air compressor’s control commands unload operation frequently.

2.There are big gap of air consumption in specific period, and facilities run all day.

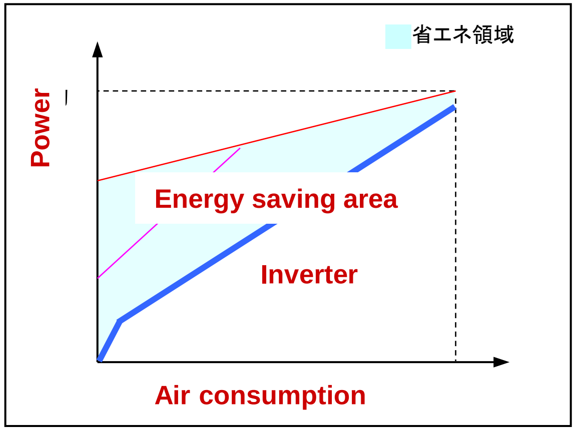
3.Air pressure is fluctuating frequently even if small amount of air is used. (unstable)

Improve on air compressor with variable speed control operation (inverter).

Unnecessary power is consumed when low load operation, If conventional type capacity control (U type) and Integral operation (I type). Easy to reduce unnecessary power, only to adopt inverter control.



Apply to variable speed control (inverter)



Example of energy saving for inverter compressor

■ **Application procedure**

Carry out energy consumption analysis for air compressor (37kW conventional model x 1 unit evaluation)

Analysis result

- Average load ratio: 52%
- Power consumption 23,600kwh/m

Details of improvement

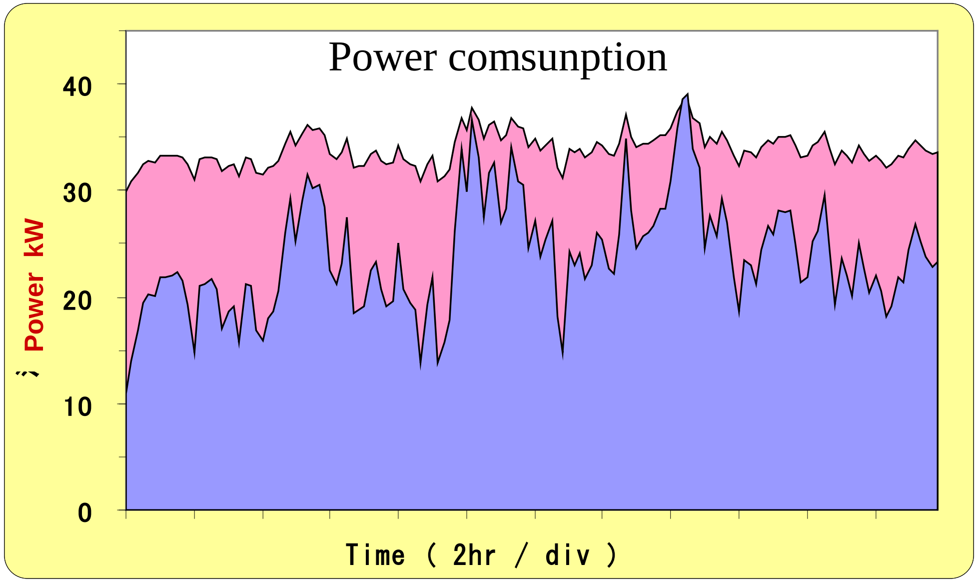
- 37kwh inverter compressor x 1 unit
- Power saving : 34%

■ **Investment and effectiveness**

- Apply to new 37kw Inverter compressor
- Efficiency of energy saving 110M¥/Y

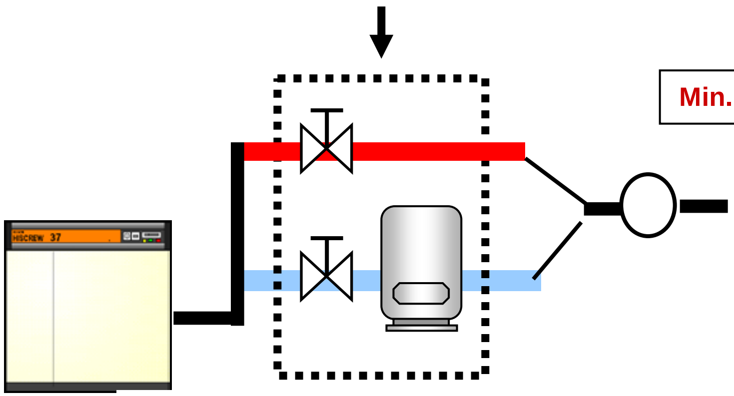
■ **Other effectiveness**

- CO2 reduction (▲34%) for environment protection
- Peoridical overhaul and parts durability last long (per 8 years)
- Maintenance cost is reduced 30%
  (our company calculation)

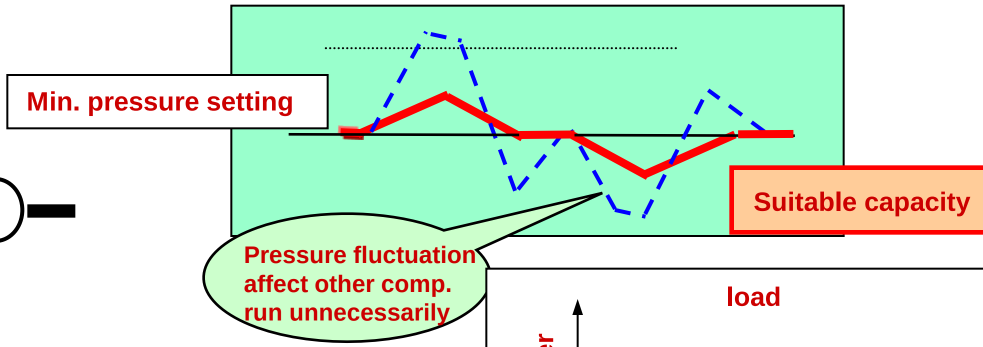


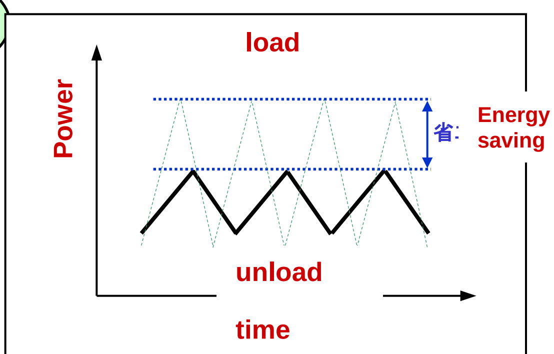
Effect of receiver tank if pressure fluctuation is frequently

Air receiver tank & bypass valve



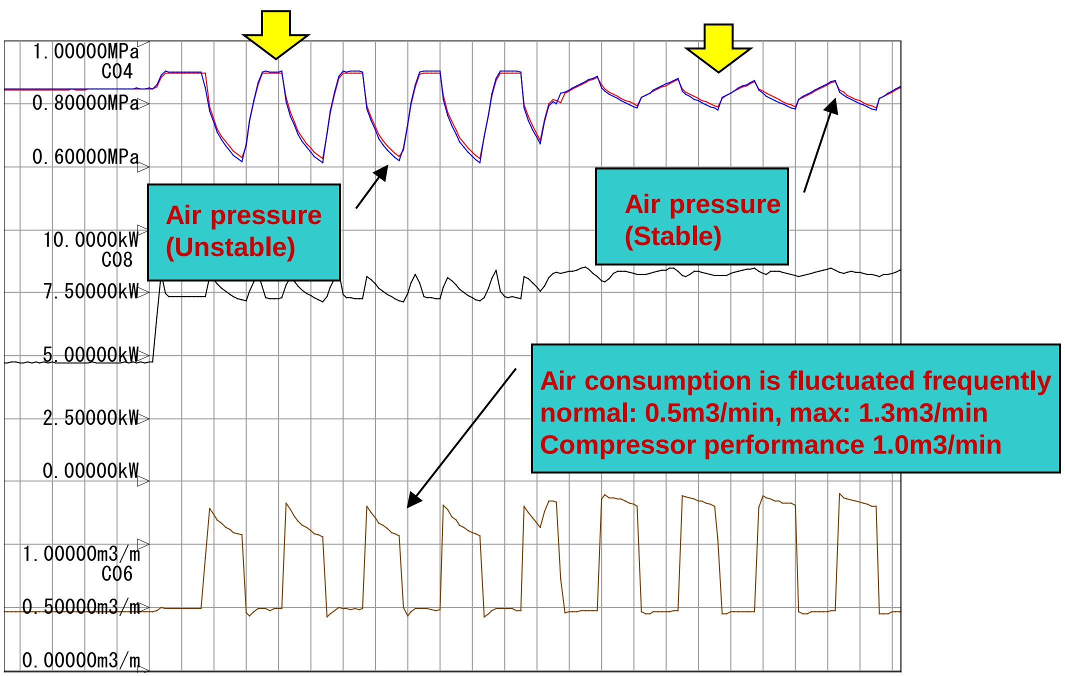
Unnecessary fluctuation affect safety valve open





Without receiver tank

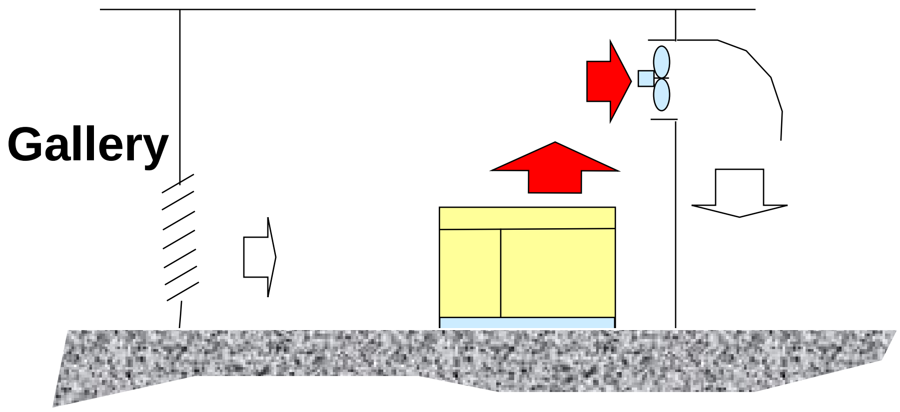
With receiver tank



Any difference with / without air receiver tank?

Ventilation and Ventilating Fan Capacity

Required ventilation amount for general ventilation



$$Q = \frac{n \times H}{0.0753 \times \Delta T}$$

Q: **Required ventilation amount** (m^3/min)

H: **Amount of heat produced per unit** (MJ/h)

(1 kW = 3.6 MJ/h)

n: **Number of units installed**

T: **Allowable temperature increase**

(When outside temperature is 35 °C, compressor's allowable maximum temperature is 40 °C, ΔT = 40 - 35 = 5 °C)

Notes

Air intake into the compressor room. (Pay attention to the gallery design - effective area.)

Install the compressor in the direction so that a hermetically-closed room or intake of contaminated air (oil, gas, etc.) is avoided.

Prevent the air discharged from the compressor room from being sent back into the room and circulating.

Discharge air in compressor room

Install the fan high on the wall of the compressor room.

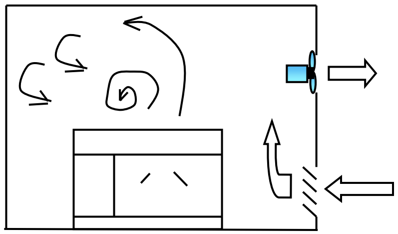
When using a rain hood, take resistance into consideration when selecting a ventilating fan.

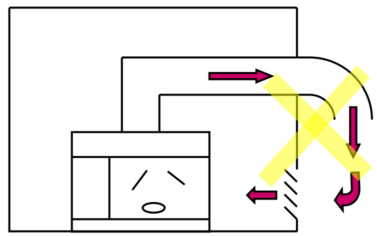
Notes for Duct Installation Work

Basically, provide a suction port low on the wall on the opposite side of the discharge port.

Be careful that the discharge port and suction port are placed on the same side.

In such a case, the room will not be ventilated at all.

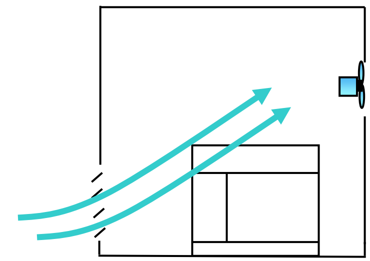




It's hot!

Temperature increase trouble due to shortcut

Smooth air flow
Appropriate cooling

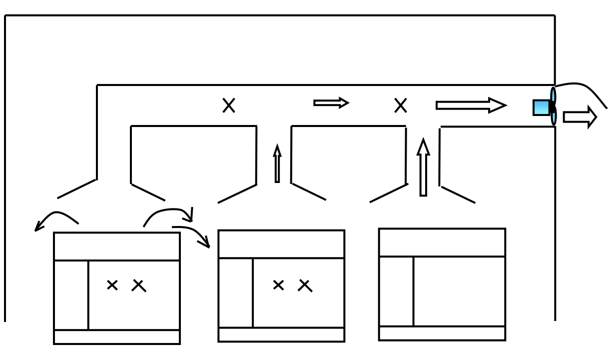


Be sure to provide a separate discharge duct for each compressor. Do not share a discharge duct for 2 or 3 compressors.

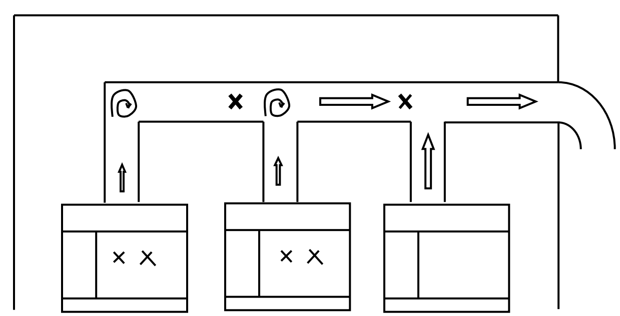
Air will not be discharged properly, leading to a failure.

The same rule applies when air is discharged through a duct using a blower or ventilator.

Even with forced exhaust, if ducts are combined into a single duct, balance will not be maintained. Overflowing discharge air may be taken into the neighbor machine.



Air is not taken in! It's hot!



Air is not discharged!

3. Improvement local pressurizing

What is efficient way to pressurize higher locally within the air supply system.

Do you have similar cases in below?

1. **Many pressure intensifier installed.**

   [because:]

   - There are quite a lot of equipment requiring high pressure.

   - Capacity utilization raises in certain hours, causing pressure down.

2. **Keep high pressure in whole system just because only a part of piping needs higher pressure.**

Characteristics of pressure intensifier

[Advantage]

- Installation is easier for local pressure raising.
- No need for electricity.

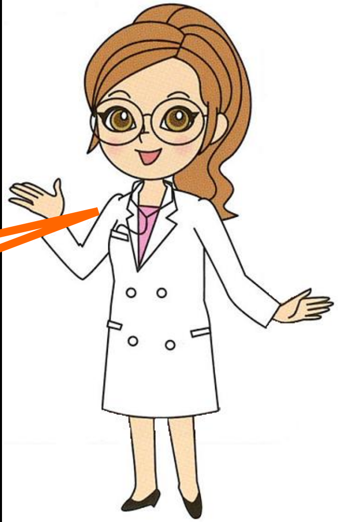
[Disadvantage]

- About half amount of air is wasted to atmosphere.
  (the wasted air was originally compressed by using electricity.)
- Shorter overhauling. (in general, 1 Milion cycles).
  In certain case, only 3000 hr may be maintenance cycle.

If you replace the intensifier with Booster Babicon,
you will have the following advantage

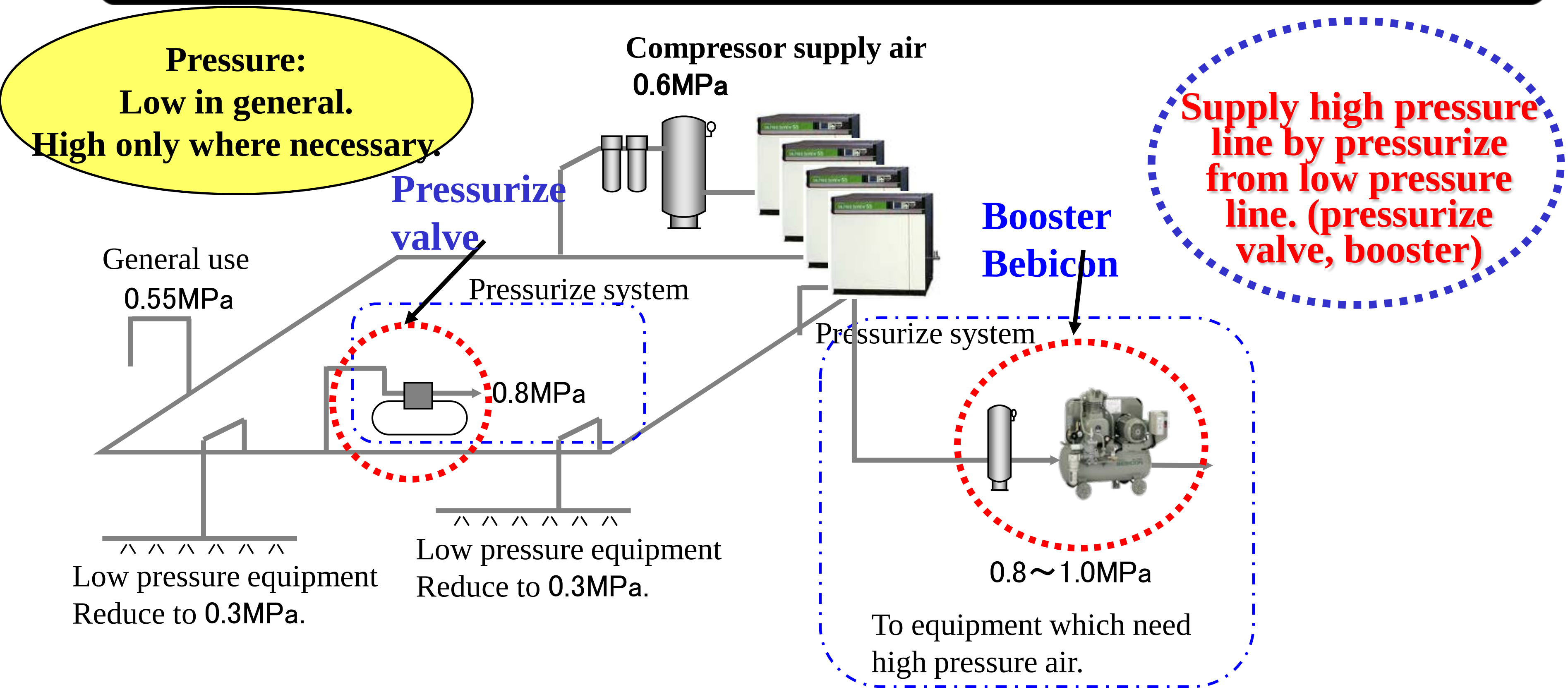
1. **Reduce air consumption.**
   - Booster babicon in-take compressed air and pressurize efficiently.

2. **Long maintenance cycle**
   - 6000 Hr is overhauling maintenance period, which is quite long!



Let's feel it! How small the required air
if the pressure intensifier is replaced with booster babicon.

Effective Usage --- local high pressurize



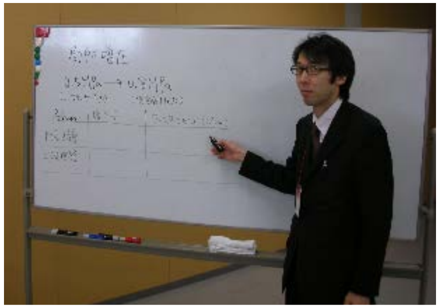
All the equipment in a factory are running not at the same pressure.
It is effective for energy saving to install pressure reduction system for low pressure line and high pressure system for high pressure line.
For local high pressurization, pressurize valve, booster is good, especially, booster bebicon works as multi-compression causing more energy saving.

Effective utilization･･･Energy saving between pressurize valve and booster bebicon

In order to make intensive pressure, there are two methods of compression :
Pressurize valve and Booster compression

Pressurize Valve

How much is the air capacity and the air consumption when pressurize valve are used?



Calculation･･･ Which is one is better for energy saving?

Booster Compressor

What kind of advantage the booster bebicon has?

Pressurize Valve

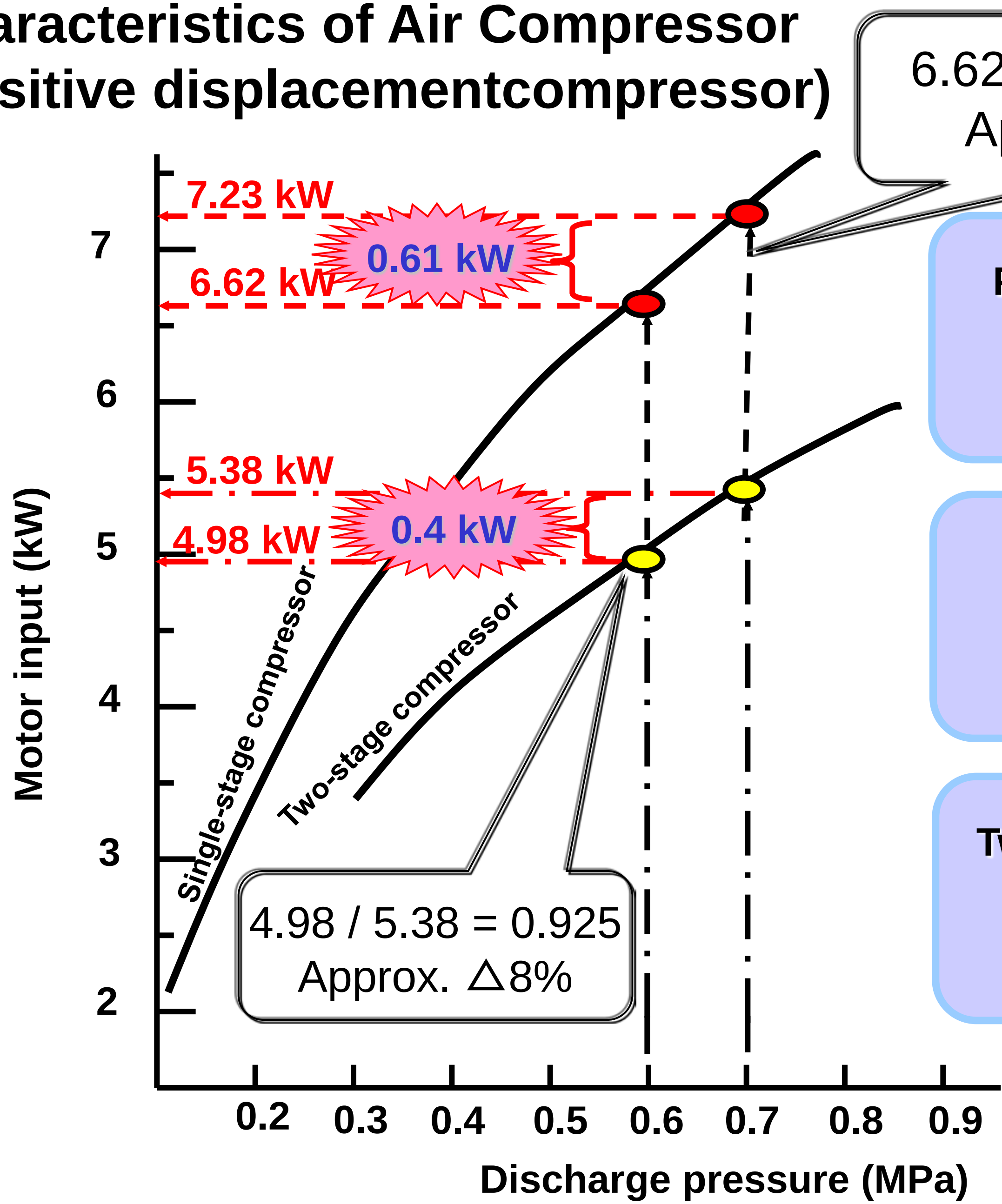
Pressurize valve does not require electricity, so it is easy to install and use.
However, twice as much air is required from source air.
For example, if 500L/min of 0.8MPa air is necessary, it means 1,000L/min of source air is required.
500L/min out of 1,000L/min is exhausted as working air for pressurization. ･･･ wasting air

Booster Compressor

Booster Compressor is all air compressed and discharged by itself without any air loss.
Air loss is almost zero during compression process.
Since only little power is used for compression, electric cost is also very little.

Cost saving for 1.5kW power => 110k¥/year.
(Cost calculation : Electric power cost 15yen/kwh, 6,000hr/year)

Characteristics of Air Compressor (positive displacementcompressor)



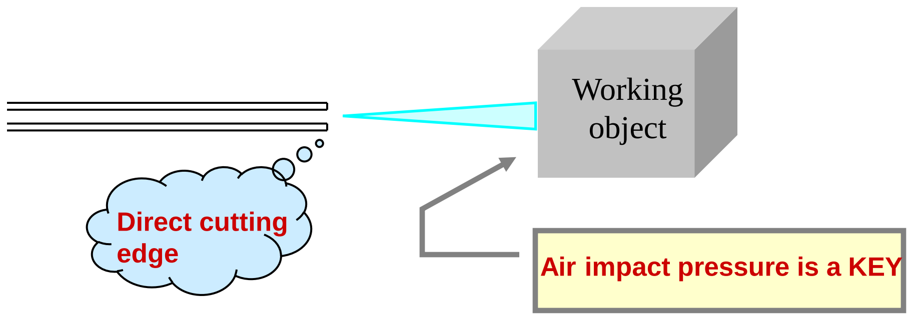
Power consumption when 1 m^3/min of air is compressed

The lower the discharge pressure, the lower the power required for compression.

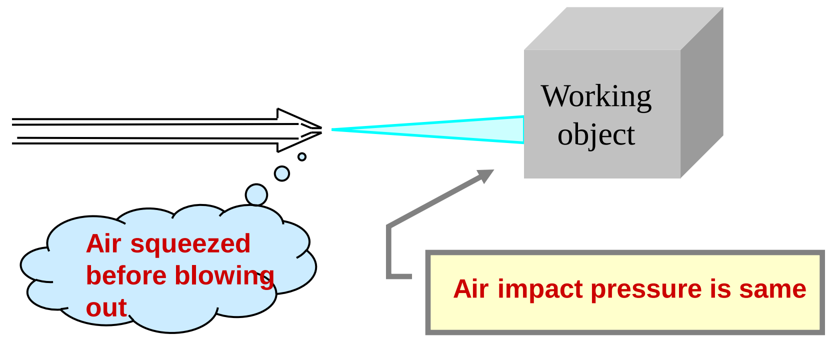
Two-stage compressors can compress air with lower power.

Example of effective air blow・・・・How much effect?

Air consumption is big for air blow when using direct cutting edge of long pipe



Air blow is much effective when using air nozzle attached just before cutting edge



<u>**Pressure loss big = Air consumption big**</u>

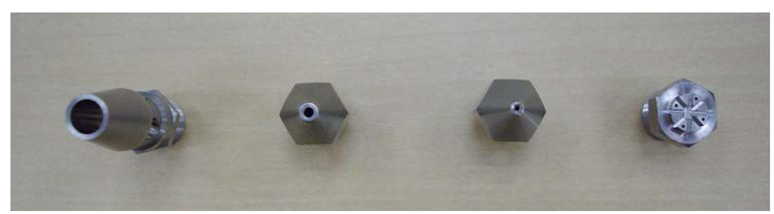
<u>**Pressure loss small = Air consumption small**</u>

Comparison of pressure loss between direct cutting edge of pipe and blow gun

Brow gun

When air blow pressure made high・・・・

Even if pressure reduction is made, air blow contacting pressure is the same as before and after.

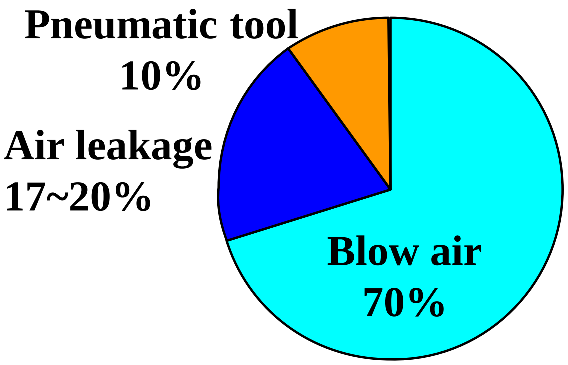


Shapes of nozzle promote air blow different

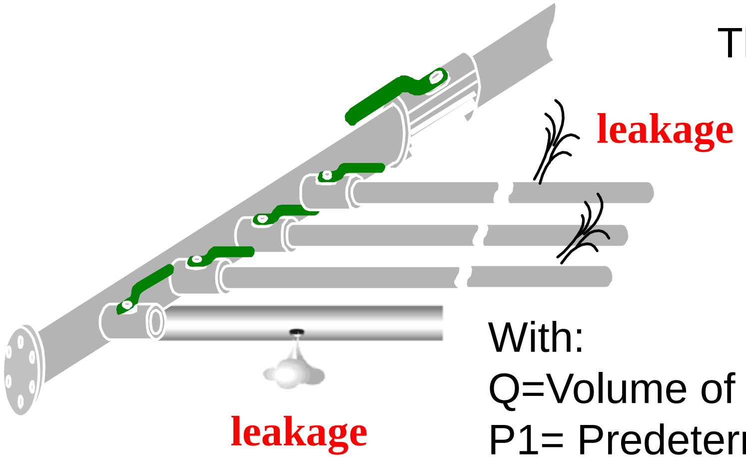
leakage

Recommendation: determine total leakage and reduce it

Leakage Checking Method



1) Operate compressor at night, or holiday, and shut it down when achieving a predetermined pressure value.
2) When the compressor is shut down, due to the leakage, the pressure will automatically decrease. The amount of leakage can be known by measuring the <u>time (T) taken to decrease the pressure by </u>1 bar.



The formula to determine the leakage (Q) is given below:

$$Q = \frac{(P1 - P2) \times V}{Po(1.033) \times T}$$

With:
Q=Volume of leakage (M3/min)
P1= Predetermined pressure (kg/cm2) (gauge pressure + 1.033kg/cm2)
P2= Pressure after leakage (kg/cm2) (gauge pressure + 1.033kg/cm2)
T=Time taken to reduce pressure from P1 to P2 (min)
Po= Atmospheric air pressure(kg/cm2)
V= Piping capacity (Mm3) (In case of your company; 72.31m3)

Air Leakage at Various Areas and Energy Loss

There is a report that as much as 20% of leakage exists in a plant on average.
Since leakage directly leads to energy loss, it is the highest priority issue for air systems.
Be aware that leakage may occur anywhere.

If there is a leakage of 200 liters per minute, the annual loss cost is: (assuming 1 M^3 = 1.8 yen)
200 ÷1000 x 60 x 8000 hrs/yr x 1.8 yen/kWh = 172, 800 yen/yr.

Understand the difference between external leakage and internal leakage

Check the leakage point example and leakage amount.

(1) Leakage from a pipe

(2) Leakage from a coupler

Note that a leakage often occurs at valves and joints.

(3) Leakage from an internal component of a device

Internal leakage may occur at a solenoid valve, air cylinder, or other components.

The air leak point

Leakage cases

20% of leakage exists in a plant on average

point;valves

17.4L/min

point;air gun

49.2L/min

point;hoses

59.4L/min

point;hose joint

59.4L/min

point;regulator

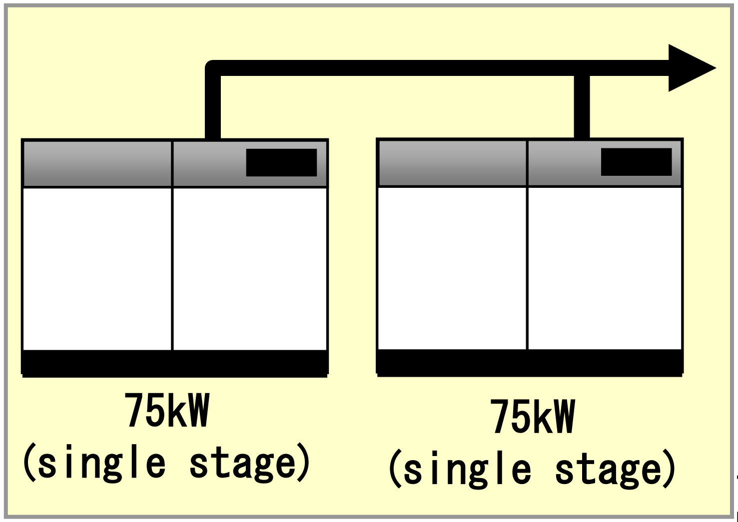
71.7L/min

point;coupler

27.7L/min

Adopt 2 stage compressor with higher efficiency

If compressors are almost all the time running at full load, larger size would be better. (Note: in case the fluctuation is dominant, decentral system is better.)



offer

Adoption of 2 stage compressor

In case fluctuation is big;

	75kW x 1 unit	75kW x 2 unit	150kW x 1 unit
Input power kW	81.0	162.0	160.0
Air Delivery m^3/min	12.4	24.8	28.5
Specific power $kW/(m^3/min)$	6.53	6.53	5.61

16% improvement in Specific power!!!

※ Specific power = Input power ÷ Air delivery

Example of Ending Up with Increased Energy Consumption

One of 2 old machines was replaced with the latest model.
Because the latest model machine has a higher discharge air volume, it was operated as a base machine.
As a result, energy consumption increased approximately 10%.

Cause: The older machine was operated with capacity control. Because naturally it did not have good control characteristics, power consumption increased.
Action taken: Make the latest model machine dedicated for capacity control.
As a result, approximately 20% energy saving was achieved.

Existing machines

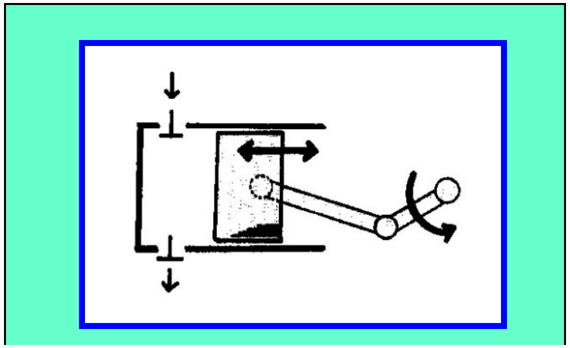
There was a need of energy saving.

Replacement machines

The highly-efficient inverter was operated as a base machine.

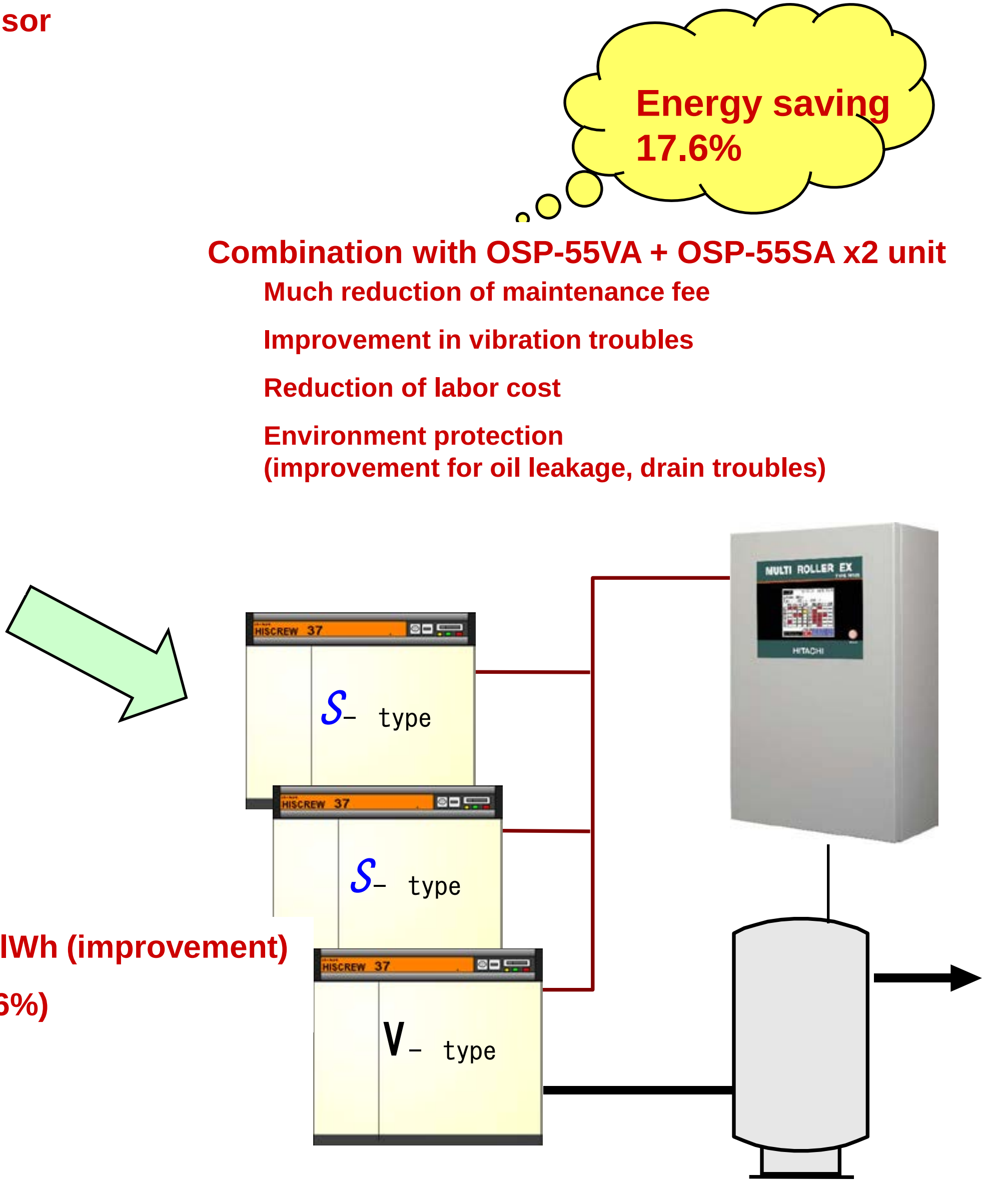
Energy saving by combination operation …

Replacement of reciprocating compressor



Replacement of reciprocating compressor

150kW class



Combination with OSP-55VA + OSP-55SA x2 unit

Much reduction of maintenance fee

Improvement in vibration troubles

Reduction of labor cost

Environment protection
(improvement for oil leakage, drain troubles)

Power consumption per year : 319,500kWh => 264,000lWh (improvement)

Energy saving : about 0.5m¥/year (energy saving 17.6%)

Example of separate operation

OS-160U5

100kW electric power was kept consuming

=> Average 54kW of power is saved

Energy saving 45%

125kW and 160kW was controlled individually by manual.

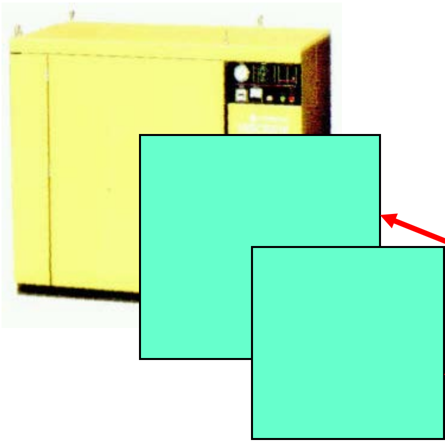
Chose suitable compressor, calculating from load ratio and necessary air consumption.

OSP-75VW x 2 units are improved to control by lead lag operation (2 units will run in a peak power)

Power consumption per year : 685,140kWh => 370,032kWh (improvement)

Energy saving : about 400M¥/year

Centralized operation for energy saving… From decentralized operation to centralized operation (power saving at night shift)



Power consumption per year 303,920kWh => 169,600kWh(improvement)

Energy saving about 200M¥/year

Only few air is discharged from 3 units of compressor

In press process facility

(37kW + 22kW + 15kW)

In heat treatment process facility

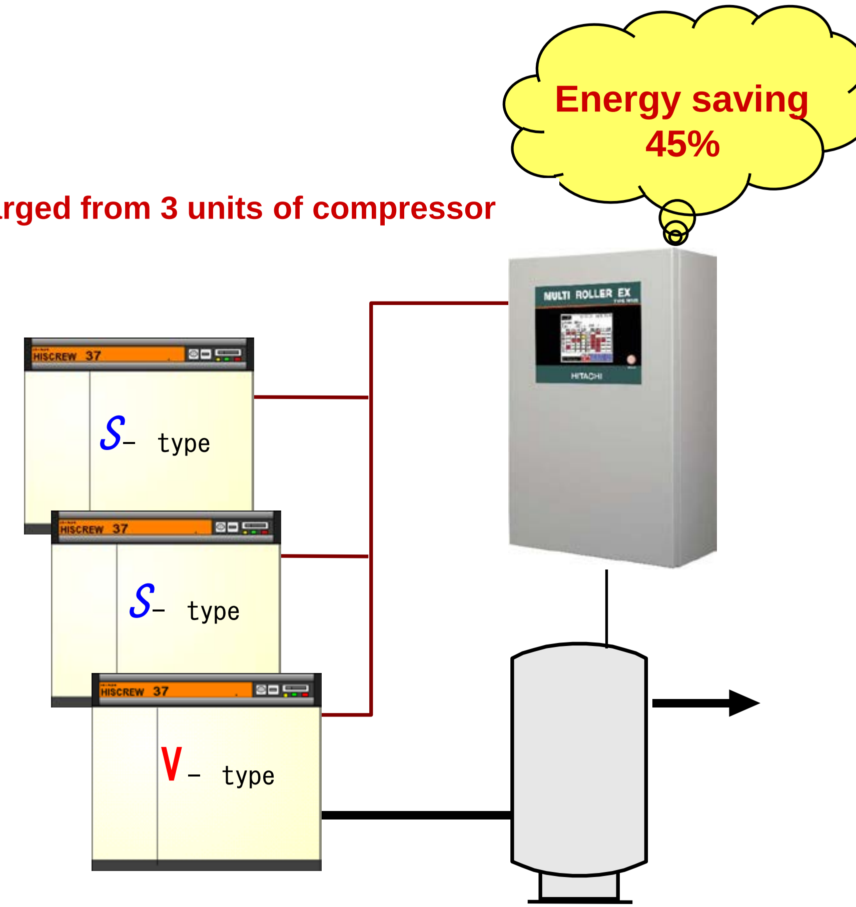
(37kW + 22kW)

improvement

・Replacement of air compressor

・Size up of piping diameter

・Install electric solenoid valve



Centralization for press process facility

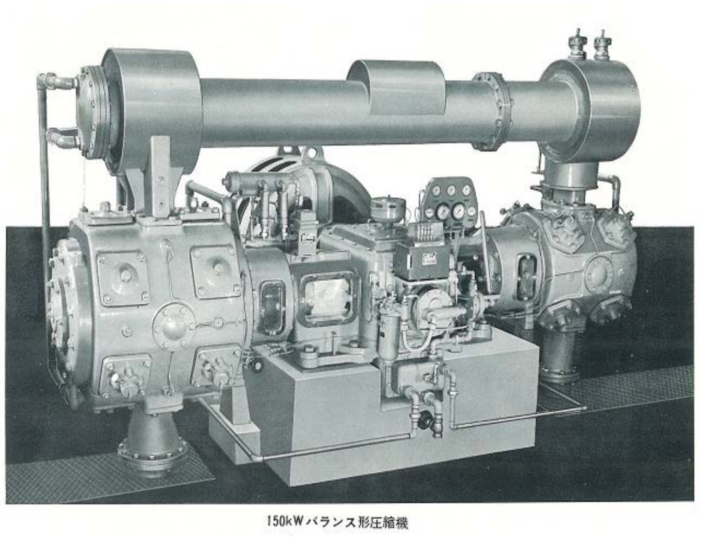
(37kW X 2units + inverter 1 unit)

Environment protection …replacement of reciprocating compressor

Low vibration, low noise level products

Environment protection is necessary !

The sound level is minimized as we can have talk easily.



150kW balanced type compressor

Improvement of power consumption in compressor room with humid environment.

Illustration of wind flow

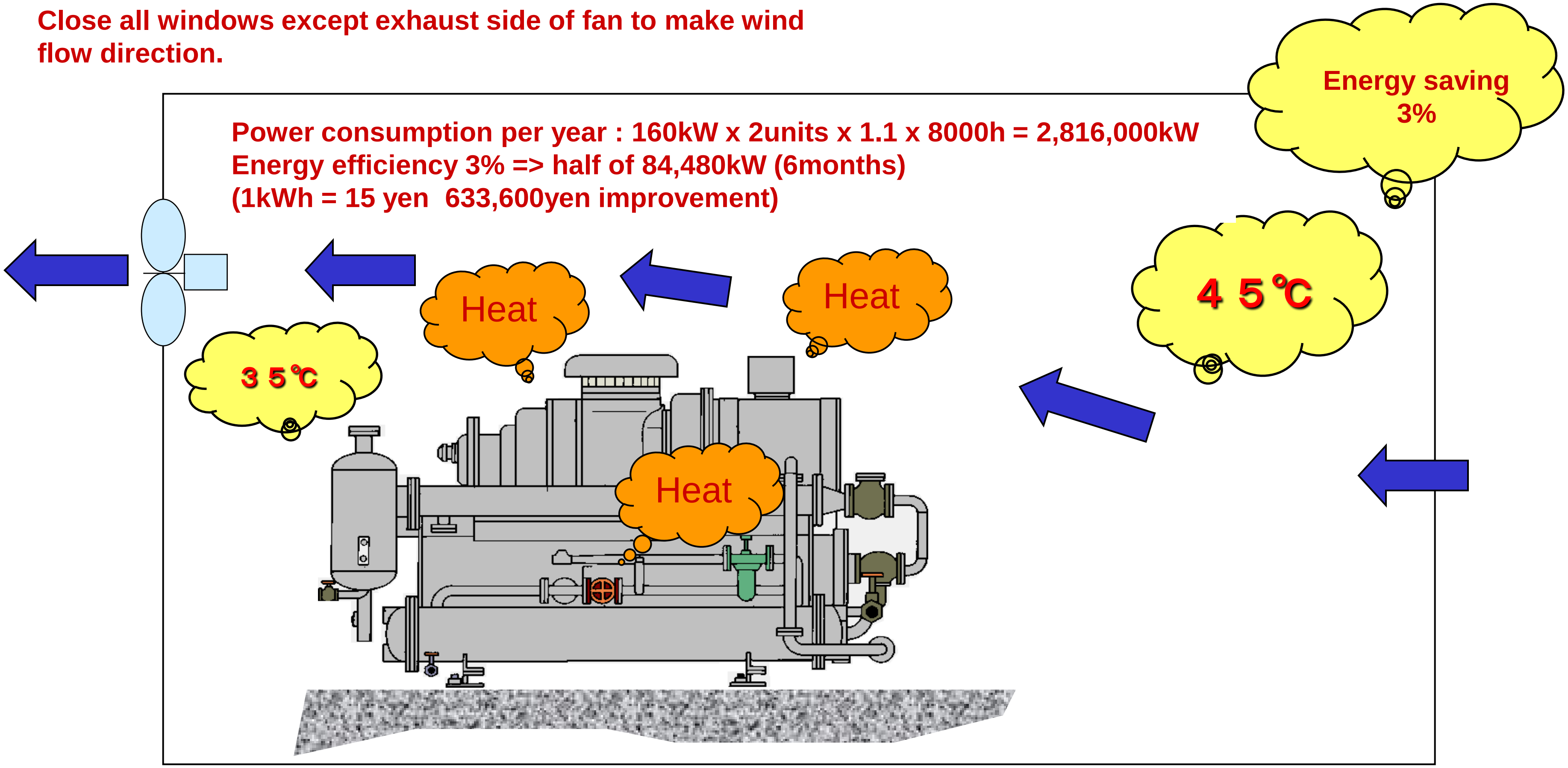
Wind flow was not good for ventilation in the compressor room, so improved wind direction in one way. (figure below)

Close all windows except exhaust side of fan to make wind flow direction.

Inner compressor temperature reduced from 45℃ to 35℃

Energy saving 3%

Power consumption per year : 160kW x 2units x 1.1 x 8000h = 2,816,000kW
Energy efficiency 3% => half of 84,480kW (6months)
(1kWh = 15 yen 633,600yen improvement)

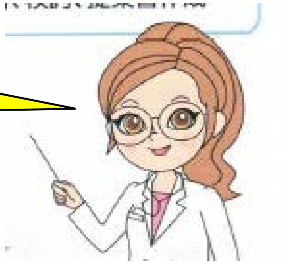


Reduction of environment load
--- Verification of reduction effect of CO2 emission

Verify how much of reduction of environment load by Compressor energy saving.

Electricity reduction per year x Coefficient of CO2 emission＝ton/year
Here adopt Default CO2 coefficient = 0.00093 (ton-C02)/kWh

CO2 coefficient is different from each electric power generation method.

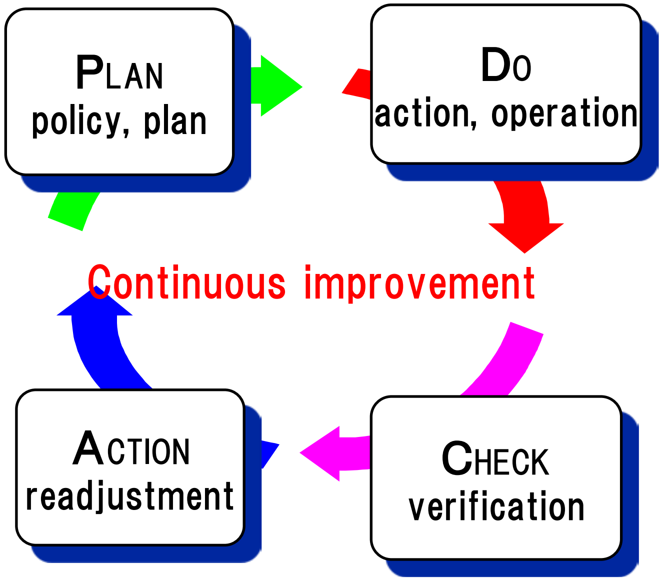


<Eg>
15kW energy saving and 4000Hr running operation per year, then CO2 cut-out is;

15 kW x 4000h x 0.00093（t-CO2/kWh）
＝55 ton of CO2 is reduced.

Plan and procedure of energy saving improvement

- ●environmental protection
- ●Energy saving act
- ●Control energy cost
  Measure, Record Log
  Maintenance, service
- ●Adopt Improvement plan,
  New process



Through above cycle, verify result of energy saving.
How much of CO2 reduction?
What for environmental protection.

Control progress by reporting, notice, thoroughness of improvement.

After achievement, make it standard, then try to improve more.
Target higher stage.

Annexure 3: Selected photographs of the workshop