MARKET OVERVIEW CUM DETAILED TECHNO ECONOMIC FEASIBILITY REPORT

(PROJECT FEASIBILITY REPORT)

ON

PVC AND CPVC PIPE AND FITTINGS MANUFACTURING PLANT

INDENTIFICATION & EVALUATION DIVISION FOR HI-TECH PROJECTS

ENGINEERS INDIA RESEARCH INSTITUTE

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J.C.: 1613
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ENGINEERS INDIA RESEARCH INSTITUTE, 4449 NAI SARAK, DELHI-110006.
PVC AND CPVC PIPE AND FITTINGS MANUFACTURING PLANT

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MANUFACTURERS/EXPORTERS

PVC PIPE MANUFACTURERS/EXPORTERS RAW MATERIAL SECTION

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DIMENSION OF PVC PIPE

PVC PIPE & FITTINGS DIMENSIONS (SCH 40 / SCH 80)

FORMULATION FOR PVC RIGID PIPES

PVC FLEXIBLE PIPES

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PLUMBING PIPES

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EXTRUSION DIES

EXTRUSION LINES:

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FILLERS OF PVC

STABILIZERS

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PVC AND CPVC PIPE AND FITTINGS MANUFACTURING PLANT

INTRODUCTION

PVC (unplasticized polyvinylchloride) pipes and fittings exhibit excellent resistance to aggressive environments both naturally occurring and as a result of industrial activity. They are resistant to almost all types of corrosion, either chemical or electrochemical in nature. Since PVC is a non-conductor, galvanic and electrochemical effects do not occur in PVC pipes.

PVC Pipes and fittings are often used in the following circumstances:

- For drinking water pipe distribution systems, both main and supply lines
- Sewer and discharge pipe systems

Due to its non-metallic nature, the material used is totally resistant to all forms of metallic corrosion.

Aggressive water resulting from high sulphate soils and low hardness water will not attack PVC pipes.

Our pipes are therefore resistant to a wide range of industrial waters and chemicals and offer an advantage in long-term systems life and manufacture costs.

For more information on the resistance of PVC for specific chemical(s), do not hesitate to let Interplast know. We inform you of the suitable pipe solution necessary.

Being made of a tasteless and odorless material, PVC pipes remain neutral to all transported fluids.

PVC is completely inert and is widely used for transporting liquids made for human consumption.
Because of their mirror-smooth inside surface, PVC pipes have minimum flow head loss. There is also no buildup of inside deposits, a particular advantage in the construction of sewerage systems.

The physical properties of PVC pipes are not affected by neither direct sunshine, nor wind or rain.

However, to avoid surface browning due to long exposure to direct sunlight, it is recommended that the pipes are kept protected from direct sunlight.

Rigid PVC is not conductive to combustion. In the event of a fire, flames are unable to travel on PVC pipes. They therefore offer added safety when used for electrical installations, both domestic and industrial.

PVC pipes are relatively light. Their specific weight 1.43 is one- fifth that of steel pipes. This cuts down transportation costs and facilitates installation when in difficult and remote places. Installation is quick and easy with a complete line of fittings either with the solvent glue weld sockets or the rubber seal socket joints. In either case, a leak-proof joint is assured. Subsequent maintenance work is also carried out with a minimum of complication and cost.

PVC pipe which is made from polymerized vinyl chloride, a synthetic resin, which when plasticized or softened with other chemicals has some rubber-like properties. Derived from acetylene and anhydrous hydrochloric acid. PVC pipe has nominal sizes that are to be used with PVC socket fittings (schedule 40) and PVC socket or threaded fittings (schedule 80).

PVC Pipe and Fittings have got tremendous demand in India as well as in abroad. To manufacture this, all the machinery and raw materials are available indigenously.

A polyvinyl chloride (PVC) pipe is made from a plastic and vinyl combination material. The pipes are durable, hard to damage, and long lasting. A PVC pipe does not rust, rot, or wear over time. For that reason, PVC piping is most commonly used in water systems, underground wiring, and sewer lines.
PVC was first developed in 1925 when a BF Goodrich employee, Dr. Waldo Semon, attempted to invent a method for bonding metal and rubber. After blending materials together to create a strong and flexible material, Semon discovered PVC. Nonetheless, the product remained virtually useless for another decade. In the late 1930's, PVC was found to have great shock absorbing abilities. This discovery led to the creation of long lasting PVC tire treads, which were created with flexible forms of PVC.

Two decades later, PVC pipe was invented. By heating the PVC material, a special machine called an extruder could be used to push the PVC into hollow pipes. This PVC pipe was extremely solid and virtually indestructible. Using PVC pipes for irrigation systems proved to be effective. PVC pipe has since been considered an affordable and reliable means for water piping.

Due to the ability of PVC pipe to withstand extreme movement and bending, it is also increasingly used in earthquake prone areas. PVC pipe can withstand the rigorous shaking of the earth without experiencing any damage. The smooth surface of the PVC pipe is also resistant to bacterial contamination, such as E. coli. Therefore, many water companies rely on PVC pipe in their systems in order to keep them free of contamination.

Unfortunately, the material used in PVC pipe appears to be detrimental to a person’s health and safety. Reported cases of PVC pipe shattering when used with high-pressured gases have increased drastically. The Federal Government has issued safety warnings, which strongly recommend using alternative piping material. In addition, the heavy metals used to create PVC pipe can leach out when heated. The vapors emitted from the heated PVC pipe are now being linked to certain forms of cancer, especially lung cancer.

CPVC Pipes and Fittings are manufactured from compound, CPVC- Chlorinated polyvinyl chloride is a thermoplastic used for hot and cold water lines. Chlorinated polyvinyl chloride (CPVC) is a thermoplastic produced by chlorination of polyvinyl chloride (PVC) resin used for hot and cold water lines. CPVC is the first choice of material for potable water supply across the world and is in use across the world for more than 50 years.
CPVC Industrial Pipe Applications

Corrosion resistant pressure pipe, IPS sizes 1/4" through 24", for use at temperatures up to and including 200°F. Pressure rating (130 psi to 1130 psi) varies with schedule, pipe size, and temperature as stated in GF Harvel engineering bulletin (Product Bulletin 112/401). Generally resistant to most acids, bases, salts, aliphatic solutions, oxidants, and halogens. Chemical resistance data is available and should be referenced for proper material selection. Pipe exhibits excellent physical properties and flammability characteristics (independently tested flame and smoke characteristics UEC, 1993).

Typical applications include: chemical processing, plating, high purity applications, hot and cold potable water systems, water and wastewater treatment, and other industrial applications involving hot corrosive fluid transfer.

Specifications

All CPVC Schedule 40 and schedule 80 pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be produced in the USA using domestic materials, by an ISO 9001 certified manufacturer, and shall be stored indoors after production, at the manufacturing site, until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.
PROPERTIES OF PVC PIPES & FITTINGS

Sp. gr : 1.36 to 1.43

Tensile strength : 450 kg f/cm², 560 kg f/cm²

Elongation : 80%

Modulus of elasticity : 30,000 - 33,750 kg f/cm²

Compressive strength : 600-700 kg f/cm²

Heat distortion temperature at 18.5 kg f/cm² : 75 °C

Coefficient of linear expansion : 55 x 10⁻⁵ m/m/°C

Thermal conductivity : 4 x 10⁻⁴ Cal/sec/cm²/°C/cm.

Flammability : Self extinguishing

Impact strength °C : 0.5 - 1 ft/lb/inch of notch.

Impact strength 20°C : 1-2 ft/lb/inch of notch.

S.P. heat : 0.24 kcal/kg/°C

Water absorption at 20°C : 0.1 in * 3* 24 hours.

Electric constant (10 cycles/80°C) : 3.0

Softening point : 82 (Vioat)

Abrasion resistance : Good.
<table>
<thead>
<tr>
<th>Property</th>
<th>Flexible PVC</th>
<th>Rigid PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Specific gravity</td>
<td>1.2 - 1.6</td>
<td>1.4 - 1.6</td>
</tr>
<tr>
<td>2. Tensile strength (lb/in²)</td>
<td>1500 - 3000</td>
<td>6500</td>
</tr>
<tr>
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<td>100 - 500</td>
<td>25</td>
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<tr>
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<td>1250</td>
<td>10,000</td>
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<td></td>
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</tr>
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<td>Temperature (°C)</td>
<td>54 - 80</td>
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<td>6. Water absorption (24 hr%)</td>
<td>0.25</td>
<td>0.1 - 0.4</td>
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<td>Resistant</td>
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<td>10. Effect of weak alkalis</td>
<td>Resistant</td>
<td>Resistant</td>
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<tr>
<td>11. Effect of strong alkalis</td>
<td>Resistant</td>
<td>Resistant</td>
</tr>
<tr>
<td>12. Solvents</td>
<td>Resistant to alcohols, aliphatic hydrocarbons and minerals eils, soluble in ketones, esters and to an certain degree in aromatic hydrocarbons and chlorinated hydrocarbons.</td>
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</table>
CHLORINATED POLYVINYL CHLORIDE (CPVC)

CPVC has been used successfully in residential, commercial and industrial applications for nearly 50 years. It is most commonly used in single-family and multi-family hot and cold water distribution systems. However, it can be used for residential fire sprinkler systems, chemical drain waste systems and industrial processing. Key advantages of CPVC include its resistance to corrosion, pitting, and scaling, ease of installation and light weight. CPVC pipe has a higher temperature resistance and is ideally suited for hot water plumbing. It can compete with Polybutene1 piping system in this application. The installation of CPVC pipe is as simple as that of PVC. It also requires solvent sealing instead of heat sealing required for PE pipe. CPVC is as safe as PVC pipe in its production, handling and installation.

Chlorinated PVC called CPVC is PVC with chlorine on its hydrocarbon backbone instead of one in PVC. It is therefore a heavier molecule and results into higher density compared to PVC, like PVC but even more difficult to process. CPVC is highly flame retardant. It has 60 Limiting Oxygen Index (LOI) indicating it requires 60% (or almost 3 times of normal atmospheric oxygen). Though PVC and CPVC belong to the plastics family and possess similar core materials, they perform very differently. The chlorination process used in making CPVC gives the material its superior performance in both high temperature and high pressure applications. The extra chlorine molecule makes CPVC very difficult to burn. CPVC will not sustain a flame on its own as there is not enough oxygen in the atmosphere to make it burn. When the flame source is removed, CPVC will self-extinguish. Additionally, CPVC should not be confused with polybutylene piping, which suffers from reliability issues because it could react unfavorably to some elements in various water systems. It's manufacture is somewhat more difficult and is in the hands of a very few suppliers.
It was first commercialized by BF Goodrich that has now become Noveon. It then sold CPVC to Lubrizol in 2001. Lubrizol supplies CPVC compounds under Temprite and also supplies CPVC processed products under Corzan brand name. Compared to PVC which has the global consumption of more than 34-35 mln tons CPVC is a niche polymer & has small consumption in the World. Similarly there are very few processing industries involved in processing of CPVC. India has few well known processors of CPVC-Ajay Industrial Corporation, Ashirvad Pipes Pvt. Ltd., Astral Polytechnik Ltd.

CPVC is an attractive alternative to glass, stainless steel, lined steel, high silicon cast iron, PP (polypropylene) and PVDF (polyvinylidene fluoride) for chemical waste and an excellent choice for long-term value. The material can withstand temperatures up to 220 degrees F. In many cases, CPVC is the most suitable solution on the market because it overcomes the most common drawbacks associated with other materials. CPVC is much easier to join than PP or PVDF systems, which require a mechanical or heat fusion installation. CPVC pipe is lightweight ◆ approximately one-sixth the weight of iron ◆ and requires no special tools for cutting. They are joined by solvent cement, the most popular material used in the chemical processing industry to join thermoplastic pipe and fittings.
ADVANTAGES & LIMITATIONS

1. PVC pipes are recommended only for water (cold) services and not the hot water supply.

2. Rigid PVC pipes are immune to corrosion and can be used in all types of corrosive soils which generally causes external corrosion in metallic pipes.

3. The specific gravity of PVC is 1.4, i.e. (5 times less than that of mild steel). Hence rigid PVC pipes can be transported easily at a lower cost handled and shaped easily. This property permits quicker and easier installation of PVC pipes.

4. The smooth well of the rigid PVC pipes reduces frictional loss to a minimum. It is about 40% lower than that of metallic pipes.

5. The thermal conductivity of PVC is some 2,650 times less than that of copper. This factor reduces insulation cost.

6. The coefficient of thermal expansion of rigid PVC is 5 to 6 * 10^-5 per 1oC. This means that in a hundred feet run the length of pipeline will after by about one inch per 10oC change in temperature. Due allowance should be made, particularly in over ground pipelines, for any change in length of pipeline which may occur during installation of when pipeline is in service.
Handling & Storage:-

Rigid (unplasticized) PVC pipes are strong but light in weight. As a result, these pipes are easily handled and are likely to be thrown about. Reasonable care, however, should be taken in handling and storage of these pipes while loading and unloading. On to and for the vehicles and these should be lowered and not dropped to the ground, to prevent damage to the pipes. These pipes are supplied in six meter lengths and above.

Extreme cold and hot weather conditions pose limitations to the handling and storage of rigid PVC pipes, and these call for suitable precautions in handling and storage. Pipes should be given adequate support at all times, stacking in large pipes should be avoided, in particular during summer months in regions where the temperature goes up to 45° C and above, as the bottom of pipes may distort, thus giving rise to difficulty to pipe alignment and jointing. During summer months pipes should preferably be stored in shade. For long term storage, pipe racks provided continuous support. For temporary storage in the field, where racks are not provided, care should be taken that the ground is level and free from loose stones. Pipes stored thus should not exceed three layers high and should be stacked to prevent movement. During summer months the pipes stored in the field should be under shade.

The impact strength of the rigid PVC pipes is reduced somewhat in cold weather, thus more care in handling is required to be exercised in these pipes in regions where the temperature goes below zero degree centigrade. At 10° C, the reduction has become marked and PVC pipes should not be laid in such conditions. While in transit pipes should be well secured and supported over their entire length.
**WIDE RANGE OF APPLICATIONS OF CPVC PIPE**

CPVC Pipes and Fittings for potable water applications are available in CTS (Copper Tube Size) ½ through 2 inches and in IPS (Iron Pipe Size) ¼ through 12 inches. CPVC Pipes and Fittings are joined by solvent cementing and CPVC Pipe and other piping materials are connected by use of adapter fittings. These CPVC Pipes are available in wall thickness of either SDR 11(Copper Tube Size), SDR - PR, Schedule 40 or Schedule 80. These pipes and fittings are pressure rated as per ASTM D 2846 for continuous use at 100 psi at 180 degrees F and 400 psi at 73.4 degrees F.

These pipes should be designed with a water flow rate between 5 and 12 feet/sec and while laying them it must be remembered that CPVC Pipes expand and contract more than metallic pipes. Compensation must be provided for expansion and contraction, where they are installed in long, straight lengths, by using offset piping arrangements like loops or bends. Adequate horizontal supports and vertical hangers at appropriate distances must be provided.

For cutting CPVC Pipes fine tooth saws/simple hack-saws/rachet saws or a circular tubing cutter modified with a plastic cutting blade can be used. Care should be taken to avoid cracking of the pipe wall while cutting. For larger diameter pipes power tools are also used at major sites for cutting.

Only CPVC solvent cements which meet the specifications of ASTM F 493 should be used while installing CPVC Pipes. Orange CPVC solvent cement or Purple primers are used when required to facilitate identification and plumbing inspection. Unpigmented CPVC solvent cement/primer, clear cement/primer, one step cements are the other alternatives available for joining purposes. Teflon Tape can be used with CPVC threaded adapters very effectively. However before using paste or pipe dope, it is better to check with the manufacturer as some of these pastes or dopes may contain solvents incompatible with CPVC.

While connecting CPVC Pipes to gas water heaters, the pipe should not be located within 6’ of the heater’s flue, to avoid the possibility of damage to the plastic pipes from the flue heat. A flexible appliance connector or metal nipple is used for the connecting. However the hot water from the heater does not affect the CPVC.
CPVC is affected by prolonged exposure to sunlight/ultraviolet radiation. Pigments are added to CPVC to make pipe and fitting resistant to degradation. CPVC pipes can be protected from sunlight /UV radiation by painting them by exterior grade latex paint.

If a section of the piping systems freezes in the cold, it can be thawed by wrapping it with a cloth saturated with hot water and keeping the cloth hot by re-dipping in hot water till required. Alternatively a low wattage heater/blower can used to blow heated air on the frozen area to thaw the pipe.

**Important CPVC related Standards**

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<tr>
<th>Standard</th>
<th>Topic</th>
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<tr>
<td>ANSI/NSF Standard 61</td>
<td>CPVC Pipes-Potable Water Supply This is a critical certification without which CPVC Pipes cannot be used for carrying potable water</td>
</tr>
<tr>
<td>ASTM D2840</td>
<td>CPVC Hot Cold Water Distribution Systems</td>
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<tr>
<td>ASTM F439</td>
<td>CPVC Schedule 80 CPVC Fittings</td>
</tr>
<tr>
<td>ASTM F441</td>
<td>CPVC Schedule 40 &amp; 80 Pipes</td>
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<tr>
<td>DIN-8079</td>
<td>CPVC Pipes Dimension</td>
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<tr>
<td>DIN-8080</td>
<td>CPVC Pipes General Quality Requirements and Testing</td>
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<tr>
<td>BS 7291/4</td>
<td>CPVC Pipes and Fittings for Hot and Cold Water Distribution</td>
</tr>
<tr>
<td>NFT 54-014-1/2</td>
<td>CPVC Pipes and Fittings for Hot and Cold Water Distribution</td>
</tr>
<tr>
<td>EN-ISO 15877:2003</td>
<td>Plastics Piping Systems for Hot and Cold Water Installations -Chlorinated Poly Vinyl Chloride (PVC - C)</td>
</tr>
</tbody>
</table>
BUREAU OF INDIAN STANDARDS SPECIFICATIONS
PLASTIC PIPES & FITTINGS


IS : 7834 - 1975 Specification for injection moulded PVC socket fittings With solvent cement joints for water supplies

Part - I General requirements.

Part - II Specific requirement for 450 elbows

Part - III " " 90o

Part - IV " " 90o Tees

Part - V " " 45o "

Part - VI " " Sockets

Part - VII " " Unions

Part - VIII " " Caps

IS : 7634 - 1975 Coke of practice for plastic pipe work for potable water suppliers.

Part - I Choice of materials and general recommendations.

Part - II Laying and joining the unplasticized PVC pipes.

PVC pipes are manufactured in different standards to suit different and applications. The following table gives comprehensive standards to which these pipes are available for different applications.
For more information contact at:

Headquarters:

Manak Bhavan,
9, Bahadur Shah Zafar Marg,
New Delhi-110 002
Phone: 91 11 23238821, 23233375, 23239402
91 23238821, 23239399 (Fax)
sales@bis.org.in

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Sales Outlets Address</th>
<th>Telephone No/Fax/e-mail</th>
</tr>
</thead>
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<tr>
<td>01.</td>
<td>Director (Sales)</td>
<td>91-11-23238821, 23233375, 23239402</td>
</tr>
<tr>
<td></td>
<td>Manak Bhawan,</td>
<td>91-23238821, 23239399 (Fax)</td>
</tr>
<tr>
<td></td>
<td>9, Bahadur Shah Zafar Marg, New Delhi-110 002</td>
<td></td>
</tr>
<tr>
<td>02.</td>
<td>Western Regional Office</td>
<td>Phone 022-28329295</td>
</tr>
<tr>
<td></td>
<td>Manakalaya, Plot No. E-9, MIDC, Road No. 8, Behind Telephone Exchange, Andheri (East), Mumbai-93</td>
<td>Fax 28374231</td>
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<tr>
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<td>Email: <a href="mailto:saleswro@bis.org.in">saleswro@bis.org.in</a></td>
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<tr>
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<td><a href="mailto:ero@bis.org.in">ero@bis.org.in</a></td>
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<tr>
<td></td>
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<td><a href="mailto:sro@bis.org.in">sro@bis.org.in</a></td>
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NOTE:- The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made there under. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a license for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.
### PRESSURE PIPES FOR WATER SUPPLY & IRRIGATION  
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# PLUMBING PIPES

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APPLICATIONS OF PVC PIPES & FITTINGS

The main application of rigid PVC pipes & fittings are:-

1. **For Transportation of Water:**

   Drinking water
   Sewerage/waste
   Rain water, and
   Salt water.

   and is used:-

   in Building
   In Laboratories
   In canteens
   In wash rooms etc.
2. **Tube wells**: -
   Hard rock and alluvial soils.

3. **Chemical processing Plants**: -
   For transport of acid - alkalis and of aggressive fluids and gases in chemical industries.

4. **Ducting for power and communication cables**: -
   5. For ducts-exhaust vapour in plants/installations underground telephone cables.

For **transportation of pulverized materials**: -
6. Electrical conduits,
7. For sprinkler irrigation,
8. Air/vent system,
9. Re-lining of old sewers,
10. Bore wall casting and suction pipes,
ADVANTAGES OF USING PVC PIPES

1. **IT IS ECONOMICAL:**

For medium sizes, PVC pipes are 10 to 30% cheaper, additional economics can be affected in installation so that the cost of large schemes can be brought down by as much as 10 to 40.

Therefore, given any allocation for water supply, more villages and more people can be provided with water supply through PVC pipes ensuring better utilization of resources.

2. **IT RESISTS CORROSION:**

Unlike most conventional materials, PVC is completely non corrosible. Therefore the life of the PVC system is much more than that of conventional materials, making it a more reliable and durable system. It also follows that PVC systems are ideally suitable for saline and other aggressive soils.

3. **NON-ENRUSTATION:**

Because of the smooth bore of PVC, there is no encrustation on the inner surface of the pipe, unlike conventional materials where the bore gets progressively smaller over a period time, owing to encrustation. This is of special advantage in congested cities, where removal and replacement of encrusted pipes from under paved streets become an extremely difficult and expansive proposition. The pressure in the distribution system laid with metal pipes also drops considerably after 20 to 25 years on account of which booster pumps have to be installed.
4. **LIGHT WEIGHT:**

The specific gravity is 5 times less than that of steel and therefore PVC pipes can be transported at low cost and handles with ease. Large lengths can be manually carried over long distances which is practically impossible with metal or asbestos cement pipes.

5. **EASE OF INSTALLATION:**

Of all plastic materials, PVC alone is capable of solvent jointing. A special solvent solution enables the piping system to be joined with great ease in a matter of minutes. The installation staff needed training and thereafter have only to follow simple procedure. Various kinds of rubber ring joints are also used to make installation even simpler. In addition, the PVC system can easily be connected to any other system.
MARKET SURVEY

Infrastructure development and urbanization in India has given a dynamic shape to the Indian construction industry. Various government initiatives like Smart City Mission, Housing for All, and Swatch Bharat Abhiyaan is creating business opportunities for construction industry. Pipes and fittings is one such essential part of the construction industry that is expected to gain momentum in the coming days due to faster developments. This industry has been segmented on the basis of types of PVC pipes and fittings (RPVC, PVC and CPVC pipes and fittings).

As per a report, PVC pipes and fittings market in India has grown at a Compound Annual Growth Rate (CAGR) of 12.5 per cent during the period from FY2009–FY2014. The PVC pipes and fittings market in India is poised to register a double digit growth over the period FY2014–FY2019 and is expected to reach Rs 391 billion in FY 2019 as compared to FY 2014. To achieve this growth, not only infra development but also progress in irrigation, waste water management, water supplies, sewage and plumbing etc is expected to play a huge role and are to be major growth drivers to spur the opportunities for pipes and fitting industry.

Sharing his views about pipes and fittings industry market size and growth rate Rajesh Pajnoo, President of Hindware Pipes Division, HSIL Ltd says, “The plastic pipe and fittings industry is Rs 23,000 crore in size with a growth rate of 17 per cent in the last 7 years. With the impetus given for Real Estate/Infrastructure development and conversion from Galvanised Iron (GI), the growth rate will improve to 20 per cent.”
Impact of GST, Demonetisation, RERA on pipes and fittings Industry

Goods and Services Tax (GST), is hailed as most important tax system in India. With its implementation it has driven up the efficiencies by cutting out the multiple taxes that are charged. It has also got much ease and transparency in the business and also has been fair enough to curb down the unethical practices. The GST is an indirect tax levied on goods and services in India wherein the goods and services are divided into five tax slabs that is 0, 5, 12, 18, and 28 per cent.

On the other hand, the announcement Demonetisation made by the government created a big hullabaloo, prolonged cash shortages etc, which slowed down various markets and sectors. However, with time the impact of the same is reduced and the money circulation is in line. Briefing on the impact of Demonetisation, GST and Real Estate Regulatory Authority (RERA) on pipes and fittings industry Pajnoo states, “Demonetisation affected the money circulation which in turn slowed down the markets in most categories, which phase is over now. GST is a positive step and a major systemic change, the impact of this is felt in real estate sector too, but we are hopeful it will settle soon. RERA will benefit the Real Estate Industry in the long run. It will attract more investment by large players and this in turn will benefit the home buyers at large.”
Opportunities for the pipes and fittings segment from Budget 2018

During the budget 2017-18 for the infrastructure sector, the total allocation for the infrastructure development in 2017-18 was Rs 3,96,135 crore. For irrigation sector, the government announced Rs 20,000 crore to NABARD for long term irrigation funds, and 5000 crore for setting up of dedicated micro irrigation fund. On the other hand, Under Swatch Bharat Mission (rural) the government prioritised pipe water supply for open defecation free villages and safe sanitation.

The budget of this year is good for the infrastructure sector, specially water and energy. The Rs.19,428 core allocation for water supply projects under AMRUT schemes will help in providing drinking water facilities to urban and semi urban households. The increase from Rs. 20,000 crore to Rs 40,000 crore for irrigation projects and dedicated micro irrigation fund of Rs 5,000 crore will help the agriculture sector to grow and have good production that will contribute to the growth in our economy. “These projects will require huge quantity of bulk pipeline to be laid for transporting water from source to destinations thus having opportunities for pipe manufacturers in India. The demand for pipes from oil and gas sector will also increase with the several development schemes by the government comes under implementation,” says Subhash Sethi, Chairman, SPML Infra Ltd.

This year’s Budget will encourage economy and also will have positive impact believes Pajnoo. On the budget expectations he states, “We expect a business friendly budget which will spur economic growth and bring a positive impact on most/all industries.”

This year’s budget with progressive thinking will lead India to an inclusive growth path with clear focus to develop robust infrastructure and lift the economy to achieve the target for next fiscal.
Imported or indigenous pipes

Like in any other country, India also has different quality of pipes and other mechanical fittings available across the market. There are good manufacturers who produce quality products which are priced comparatively higher than other manufacturers and also the Chinese imports available freely. Over the past few months, global steel prices have jumped by nearly 30 per cent thus putting pressure on pipe manufacturers. Apart from rising cost, India has also witnessed growing imports of steel and pipes from countries like China, South Korea and Ukraine despite it has got the surplus steel production. After the New Steel Policy rolled out by the government in May 2017, it helped in keeping a check on imports which reduced to only 10.9 per cent during April-December 2017.

Sethi adds, “When SPML Infra received order for phase 1 of Saurashtra Narmada Avtran Irrigation (SAUNI Yojana) in Gujarat, which required procuring high capacity 3000 mm dia MS pipes with 17.5 mm thickness, no manufacturer was having the production capacity to provide such pipes which ultimately they upgraded their facilities to manufacture and supply.”

India has about six million tonnes of pipe making capacity and imports 50-60 per cent of its raw material. China has started focusing on Indian market for pipes (after Europe imposed anti-dumping duty and the US started investigation on their exports for a possible trade barrier) and has managed to get good amount of Indian business with value-added steel pipes which are 20 per cent cheaper than Indian producers. China is able to manage the cheaper rates due to special incentives provided by their government for exports besides they enjoy lower interest and logistic costs compared to their Indian counterpart. Though the New Steel Policy mandates use of ‘Made in India’ steel for pipe manufacturing, but it still requires lot of clarifications and faces big challenges on implementation due to limited resources available.
Sharing his views on SPML Infra’s preference on indigenous pipes Sethi says, “As an Indian Company working in infrastructure sector for past over three decades, SPML Infra is mainly using pipes and fitting manufactured in India. The preference is purely based on quality either for imported or indigenously manufactured with proper delivery commitment by the supplier as per our project execution schedules. We have seen Indian pipe manufacturers transformed from their conventional pipe making methods to adopting technology and modern technique to implementing stringent quality control for producing high capacity advanced pipes like MS and HDPE with large diameters. Earlier we used to lay PSC and RCC pipes which have given way to modern HDPE, DI and MS pipes with high tensile strengths. Sometimes the home grown manufacturers are not able to meet the committed dates due to their limited production capacities and gap between demand and supply. In such cases, companies like us have to look for other options in line with quality and quantity requirements.”

SPML Infra has extensive experience in laying, jointing, testing and commissioning of bulk and distribution pipeline network for domestic and industrial water supply, treating water for reuse from sewage, effluent, irrigation, institutional, power etc. It has achieved a major position in the segment and already laid more than 10,000 km of pipeline up to 3,500 mm diameters in different geographical regions of India. It has developed expertise for both the business and technical management of large pipe networks with planning, laying and managing cross-country pipelines of any length and size (up to 4000 mm diameter) in all terrain conditions for drinking water, wastewater, irrigation, power and flood water transportation and management.

SPML Infra has earlier completed laying of 41 km of 3000 mm dia MS pipeline with 17.5 mm thickness with external 3LPE coating and internal food grade epoxy coating under the Saurashtra Narmada Avtran Irrigation (SAUNI Yojana) in Gujarat. It is currently executing another package for laying of 36 km pipeline with same specifications. It has also executed 21 km of 2764 mm MS pipes with 18 mm shell thickness under Cauvery Water Supply Scheme for water supply augmentation to Bangalore city.
The over 9 km 2,420 mm to 3,100 mm dia MS pipeline was laid by the company in Delhi to improve raw water supply arrangement for the treatment plant at Wazirabad.

While stating on whether the industry imports only components of the product or the entire product Pajnoo says, “Few MNCs which are importing their products, but the volumes are low. In addition on suggesting how to avoid imports he says, “We are focussed on giving the Best Quality products manufactured here, given the low volumes of imported products, it is not a worry for us.”

**New venture in pipes and fitting segment**

It is very important that India has good number of manufacturers and HSIL Ltd who has recently ventured into the household plumbing pipes segment with the inauguration of their manufacturing facility in village Isnapur, District Medak, Telangana. The move is aimed at providing integrated solution for home building, enhancing customer convenience, facilitating cross-sale and extending the existing building products distribution chain to the hardware channel distribution chain for the pipes sub-segment.

Briefing about the facility’s production capacity Pajnoo says, “The HSIL plant currently has a total production capacity of 30,000 metric tonne with plans to scale up the production capacity to up to 60,000 metric tonne by 2020 in order to emerge as a key player in the CPVC and UPVC pipes and fittings segment. This plant is the epitome of the best manufacturing practices accumulated and market understanding from HSIL’s existing operations.”

The plant will manufacture all types of CPVC and UPVC pipes and fittings, suitable for potable water transportation, water harvesting and sanitation applications, primarily in building construction segment.
Pajnoo adds, “We are extremely excited to launch our manufacturing plant in Isnapur, Telangana. To ensure product and technological supremacy we have entered into an alliance with Japan’s Sekisui Chemical Co. Ltd. which is a 70 year old $9 billion turnover company, for the supply of chlorinated polyvinyl chloride (CPVC) compound under their brand name Durastream, which is NSF certified. We are confident that our legacy of over five decades and this strategic partnership will enable us to provide better quality heatresistant pipes and fittings and offer best in class products to the Indian market.”

Future growth of India PVC pipes and fittings Market is expected to be led by the rising construction of much required residential units and inclining demand of PVC pipes and fittings in agricultural sector to bring in more area under cultivation. This will also be bolstered by the government projects for clean environment and housing for all which includes a large focus on the sanitation facilities for the people.

The market leader, Finolex Industries Limited is expected to maintain focus on research and development in its manufacturing plants to develop new products and widen its distribution reach, to stay ahead of its rivals in the market especially in rural segment.

The Indian PVC pipes and fittings industry, which comprises of segments such as RPVC, PVC and CPVC pipes and fittings has grown significantly over the last few years due to the increase in the demand from irrigation sector on account of the burgeoning population and uncertain weather conditions in the country. The PVC pipes and fittings industry in India is highly fragmented. The market revenues have grown at a CAGR of 13.4% from FY’2010-FY’2015. There is a stiff competition in the market with a large number of organized and unorganized players engaged in the manufacturing and distribution of PVC pipes and fittings in the country. Jain Irrigation Limited dominated the market in terms of production capacity in FY’2015.
“PVC pipes will gradually replace conventional piping systems in the market due to their lower cost and higher durability. CPVC pipes are expected to register fastest growth in terms of the production capacity in the next 5 years from FY’2015-FY’2020. Rising acceptance of CPVC pipes over galvanized or PVC pipes will lead to the growth in the future. The organized segment of the market is predicted to grow at a faster rate in the coming years with shifting preferences towards branded and quality products being witnessed in the domestic market”.

Currently in India approximately 73% of PVC is consumed by the pipe & fitting industries with the other sectors comprising only 27%.

Globally pipes & fitting account for only 43% of the PVC consumption showing PVC application in India other than pipe & fitting are still in the early stages and are primed for growth.

Although CPVC pipes & fittings contributed just 10% to the overall production capacity in 2017. It's the fastest growing segment of the PVC pipes and fittings industry in India.

An entrepreneur can well venture into this field.

The Reliance group, through Reliance and IPCL, accounts for two-thirds of the market share. The next largest player is Finolex group, which has a 16 per cent market share. The next two DCW and Chemplast have shares of 8 per cent apiece. The remaining share is catered to by DCM Shrirams. PVC has a unique position in the plastics sector on account of its unique features, and is headed for robust long-term...

India PVC pipes and fittings Market is expected to reach INR 391 billion by FY’2019

Future growth of India PVC pipes and fittings Market is expected to be led by rapidly increasing population leading to increased demand for agricultural production, expanding housing sector and significant role played by the government in the development of irrigation infrastructure and real estate sector in the country.
The market leader, Finolex Industries Limited is expected to maintain focus on research and development in its manufacturing plants to develop new products and widen its distribution reach, to stay ahead of its rivals in the market.

The Indian PVC pipes and fittings industry, which comprises of segments such as RPVC, PVC and CPVC pipes and fittings has grown significantly over the last few years due to the increase in the demand from irrigation sector on account of the burgeoning population and uncertain weather conditions in the country. The PVC pipes and fittings industry in India is highly fragmented. The market revenues have grown at a CAGR of 12.5% from FY’2009-FY’2014. There is a fierce competition in the market with a large number of organized and unorganized players engaged in the manufacturing and distribution of PVC pipes and fittings in the country. Finolex Industries Limited dominated the market in terms of production capacity in FY’2014.

The India PVC pipes and fittings market will grow at a double digit CAGR over the period FY’2014-FY’2019 and is projected to reach INR 391 billion by FY’2019. Increased government’s thrust on infrastructure development, rising demand from construction sector, expansion in the housing sector and burgeoning population leading to increased demand for agricultural production, will drive the market growth in the coming years.

“PVC pipes will gradually replace conventional piping systems in the market due to their lower cost and higher durability. CPVC pipes are expected to register fastest growth in terms of the production capacity in the next 5 years from FY’2014-FY’2019. Rising acceptance of CPVC pipes over galvanized or PVC pipes will lead to the growth in the future. The organized segment of the market is predicted to grow at a faster rate in the coming years with shifting preferences towards branded and quality products being witnessed in the domestic market.

P.V.C. rigid pipe means Poly Vinyl Chloride rigid pipes. P.V.C. is a thermoplastic resin used for various flexible and rigid production. The major application among PVC rigid is the PVC rigid pipe. The major application of PVC rigid pipes are in handling chemicals, water lines, water filtration and sewage plants, air-conditioning, oil and gas applications, ship board piping, electrical conducts etc.
The PVC pipes are as an ideal substitute for conventional pipes such as galvanized iron pipes, Cast Iron spun pipes and cement pipes in many areas. PVC pipes is latest innovation and have several advantages our conventional pipes. PVC pipes score over other pipes by virtue of this following properties.

1) Non collision.

2) Light weight.

3) Low cost of Transportation handling, and storage.

4) Low Installation costs.

5) Smooth Interval and external surface, thus ensuring negligible friction resistance of fluids.

6) High inertners to chemical reaction.

7) Bad conductors of electricity.

8) Low thermal conductivity.

9) Self extinguishing characteristics.
PRODUCTION OF PVC AND CPVC PIPES
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<td>1,65,740</td>
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</tbody>
</table>
# APPLICATION BREAK UP OF PVC IN INDIA

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes &amp; Fittings</td>
<td>73</td>
</tr>
<tr>
<td>Flooring</td>
<td>8</td>
</tr>
<tr>
<td>Wire &amp; Cable</td>
<td>5</td>
</tr>
<tr>
<td>Films &amp; Sheets</td>
<td>5</td>
</tr>
<tr>
<td>Profile</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
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</table>
# GLOBAL APPLICATION OF PVC

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>%age</th>
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</thead>
<tbody>
<tr>
<td>Pipes &amp; Fittings</td>
<td>43</td>
</tr>
<tr>
<td>Flooring</td>
<td>3</td>
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<tr>
<td>Wire &amp; Cable</td>
<td>8</td>
</tr>
<tr>
<td>Films &amp; Sheets</td>
<td>17</td>
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<tr>
<td>Profile</td>
<td>19</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
## PRESENT CONSUMPTION PATTERN OF P.V.C. RIGID PIPES

<table>
<thead>
<tr>
<th>S.NO.</th>
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<tr>
<td>1.</td>
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<td>40</td>
</tr>
<tr>
<td>2.</td>
<td>Oils and gas</td>
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</tr>
<tr>
<td>3.</td>
<td>Marial Drain Sewage Lines</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>Electric conduct</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Others</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>
PVC pipes offers the following advantages:-

- Low Cost of materials.
- Low installation cost.
- Easy handling and joining light weight.
- Non-toxic
- Resistant to most chemical
- Low hydraulic losses - smooth bore.
- Low operating and maintenance cost.
- Resistance to abrasion.
- Non conductor of electricity.
- No deposit formation.
- Low thermal conductivity.
- Can be joined to other materials.
- Low energy cost in manufacturing.
- Self colours grey - no painting or colour blending of system is required.

Today, the per capita consumption of plastics in India is only 6 Kilos, against the world average of 27 Kilos. The per capita consumption of plastics is more than 100 kilos in developed countries.
TREND IN INCREASE IN DEMAND

Trend growth rate in increase of demand = 15%

The use of plastics pipes and fittings in all regions of the world continues to grow with PVC representing over 60% of the plastic pipe used. The cost performance benefits and decades of successful use make PVC the logical material of choice for pipe applications such as drainage, sewage, drinking water and irrigation.

Within the PVC pipe market, lead based heat stabilizers are still the most widely used heat stabilizer accounting for nearly 50% of the worldwide volume. In fact, lead based stabilizers dominate the PVC stabilizer market in all regions except the North American, where lead stabilizers were phased out in the 1970s and tin stabilizers predominant. Within the Asian region including India, China, Japan and Australia lead based stabilizers still predominate but the move away from lead has accelerated.

Although the move away from lead based stabilizers in North America started in the 1970s, only recently have other regions started to initiate a move away from lead. In Europe, environmental concerns and regulatory issues have pushed for the elimination of lead based heat stabilizers over the next five years. European heat stabilizer manufacturers have made a voluntary commitment, called Vinyl 2010* to achieve a 50% reduction in lead stabilizer use by 2010 and to be lead free in 2015. This commitment also applies to the plastic pipes and fittings industry represented by TEPPFA (i). TEPPFA calls for a phase out of lead stabilizers in the EU for pipes and fittings made of virgin PVC targeting 25% reduction in 2005, 75% in 2010 and 100% in 2015. Other regions including the countries of Australia, Japan and South Africa have even more aggressive time tables for the elimination of lead stabilizers. It is expected that the rest of the world will follow with a progressive elimination of the lead based stabilizers.

This move to lead free stabilizers will cause pipe producers to re-evaluate their stabilizer options as they strive to keep the cost competitiveness of their PVC formulations. Thus, the challenge for stabilizer manufacturers is to propose new lead free stabilizers for pipes with good performance and attractive costs.
CaZn stabilizers are already proposed as alternatives to lead based stabilizers for pipe applications. However, the performance/price ratio of CaZn stabilizers has often not been viewed as being attractive enough to accelerate the phase out of lead stabilizers before regulations mandate a total change.

In an effort to produce an alternative to lead stabilizers and to overcome the deficiencies associated with traditional CaZn stabilizers, the Rohm and Haas Company has developed a new system. AdvapackTM NEO Heat Stabilizer, that is based on a derivative of the mercaptan chemistry which has been used for decades with conventional tin mercaptide stabilizers. This patented technology includes organic based, heavy metal free compositions that contain blocked thiol, which under vinyl processing conditions, generate highly active stabilizing components.

**Enhanced recycling properties for PVC pipes**

The recycling of PVC pipes is important to maintaining the environmental and financial sustainability of PVC. For example in 2006, PVC recycling in Europe doubled and the European Plastic pipe industry represented by TEPFPA continues to push for even more recycling of pipe products in the coming year.

The use of recycled PVC materials can lead to several complications including color variation and rheological difficulties due to advanced decomposition of PVC.

To evaluate stabilizer impact on the ability for recycling, PVC pipe formulations were processed, ground and re-processed several times, using either 100% recycled material or 20% recycled material mixed with 80% fresh dry blend. The Advapack TM NEO system has been compared to a commercial CaZn one pack. The impact on rheology and color has been evaluated under the test conditions.
OVERVIEW OF PVC

Fundamentally, PVC is a synthetic resin made from the polymerization of vinyl chloride. It is the third largest plastic in production and consumption. Technology has gradually improved over time with improvements in safety, product quality, production volume, environmental issues and cost. A key feature of PVC is that it can be combined with additives and fabricated into a wide variety of forms. These include pipes and fittings, profiles and tubes, windows and doors, sidings, wires and cables, film and sheets, toys and other moulded products and floorings. This quality, together with features such as durability, self-extinguishing property, resistance to most chemicals and oil, mechanical strength and ease of processing, means that PVC is a competitive and attractive option for many end uses in construction and infrastructure, agriculture, electrical products and healthcare. Further, only 43% of PVC’s content comes from oil. The balance 57% comes from salt, meaning that PVC is less dependent on fossil fuels compared to other materials. This feature, coupled with the fact that PVC products can last up to 100 years, can be recycled and can provide products with good quality to price ratio, greatly reduces life cycle costs of PVC.
Global scenario

Globally, the growth of the industry over the last 100 years has been spectacular. Production capacity has grown from a few thousand tons in the 1930s to over 50 million tons today. The global capacity break-up is given below.

Global PVC capacity break-up (%)

Source: Industry Reports
Growth in demand will be concentrated in developing countries in Asia, Africa, Latin America and the BRICS. The per capita consumption in India of 2kg is low compared to 11.8kg per capita in the US and 10.3 kg per capita in China. The forecasts for the PVC industry are bright. The global market, currently at US$ 56 billion, is expected to reach revenue of US$65 billion in 2019, with average annual demand expected to increase at 3.9%.

**Per capita consumption of Suspension PVC**

![Graph showing per capita consumption of Suspension PVC in different countries, with India at 2 kg, Brazil at 5.6 kg, Malaysia at 7.6 kg, Thailand at 8.8 kg, China at 10.3 kg, and USA at 12.7 kg. Source: Industry Reports]
The global consumption of PVC in 2014 was estimated at 40 million tons. The region wise break-up is given below.

**Global PVC demand break-up**

![PVC Demand Break-Up Chart]

*Source: Industry Reports*
Indian Scenario

India has been producing PVC for over 50 years now, with the first plant of 6ktpa capacity set up by Calico Mills Ltd., in Mumbai in 1961. After this, India never looked back till about the mid-2000s.

The figure below illustrates how, after the drop in duty levels in mid 2000s, capacity addition completely lagged demand growth, resulting in the zooming import numbers.

Figure: PVC production and imports in India
The PVC industry in India has historically been driven by agriculture till 2000. Thereafter, the main driver for PVC consumption has been infrastructure growth. For instance, Pipes & Fittings, that constituted only 4% of the total consumption in 1975, has grown to over 70% now.

**Figure: PVC demand in India - History**
Currently, in India, approximately 73% of the PVC is consumed by the Pipes & Fittings industries with the other sectors comprising only 27%. Globally, Pipes & Fittings account for only 43% of the PVC consumption, showing that PVC applications in India other than Pipes & Fittings are still in the early stages and are primed for growth. This, along with the relatively low per capita PVC consumption in India, shows that future prospects for the Indian PVC processing industry are bright.

**Figure: Application break-up of PVC – India**
The total demand for PVC in the country in 2014-15 was at 2,564kt. The demand grew by 6% compared to 2013–14.
The figure below illustrates how, after the drop in duty levels in mid 2000s, capacity addition completely lagged demand growth, resulting in the zooming import numbers.

**Figure: PVC consumption in India (2001-2015)**
For the period between 2002 and 2015, the total demand for PVC in the country grew at a CAGR of 8.7%. During the same period domestic production capacity grew at a CAGR of 4.6% whereas imports grew at a CAGR of 32.5%.

The domestic manufacturers and their respective current capacities are given below:

**Figure: Domestic manufacturers and capacities (kT)**

![Bar chart showing the domestic manufacturers and capacities]
MANUFACTURERS/EXPORTERS

Mr. Indraved Rai
The Supreme Industries Ltd.
1161, Solitaire Corporate Park,
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Chakala, Andheri (E) 400093
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Mobile No:07506545950
E-Mail Id : indraved_rai@supreme.co.in

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Uttar Pradesh (INDIA)
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Email: info@vectus.in

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Barcelona Polyplast
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Ahmedabad-382430 (Guj.) India
MOBILE : 09512760822
E-MAIL : barcelona.polyplast@yahoo.com
info@angelcpvc.com
WEBSITE : www.angelcpvc.com
Prince Pipes & Fittings Pvt. Ltd.,
The Ruby, 8th floor,
29, Senapati Bapat Marg (Tulsi Pipe Road),
Dadar (West) Mumbai - 400 028, INDIA.
Ph: + 91 - 22 - 66022222
Fax:+ 91 - 22 - 66022220
Email:info@princepipes.com

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Gondal Road, Behind Hotel Krishna Park,
Shivam Industrial Estate,
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Rajkot, Gujarat
- 360004
Phone : +91-281-2363340
Fax : +91-281-2363360
Mobile : +91-8469777770, +91-8758312578
Email Address :info@pipesandfittings.co.in
Web Site :http://www.nijanandpipesandfittings.co.in

Modern Plastics Company
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B/H Rudra Building
Opp. Manmohan Sweet
Ambawadi Bazar,
Ahmedabad - 380006 (Gujarat) India
Phone : 91-79-6921440, 91-79-65251244,
91-79-26441144, 91-79-26441244
E-mail : sales@pvcpipe.in, purchase@pvcpipe.in, info@pvcpipe.in
Miraj Pipes & Fittings Pvt. Ltd.
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Pin Code : 313001
Mobile : +91-9549999893, 08045135102
Email : jitender.singhal@mirajgroup.in

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Mobile : +(91) - 9830036400, +(91) - 9830323860
Phone : +(91) - (33) - 22623124, +(91) - (33) - 22623125

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Fax : +91-33-2243 2395
Email : contactus@oriplast.com
customescare@oriplast.com
40 Strand Road, 5th Floor
Kolkata - 700001
Phone : +91-33-2243 3396/97
Fax : +91-33-2243 2395
Toll Free : 1800 123 2123
Email : sales@oriplast.com
sales@orimarketing.com
Bengal Sales Office
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Phone : +91-33-2283 9054/58
Fax : +91-33-2283 9059
Email : corporate@oriplast.com
sales@oriplast.com

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Wazirpur District Center
Pitampura, New Delhi - 110034
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Tele Fax : +91-11-4370 2640
Email : northsales@oriplast.com

Polysil Pipes
25, Maker Chambers III,
Nariman Point, Mumbai – 400 021,
Tel : 022 40502500, 022 22843540
Fax : 022 66306418
Email : pchawla@polysilpipes.com

Ajay Polymers
503/A-09, GD-ITL Northex Tower,
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Pitampura, New Delhi - 110088
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E-mail : info@ajaypolymers.in
Web : www.ajaypolymers.in
Works : 14th K.M.Stone,
Delhi Road, Hissar - 125044
Haryana, INDIA
Phone +91 166 - 222615, 2285126
E-mail : info@ajaypolymers.in, sales@ajaypolymers.in
Web : www.ajaypolymers.in
Prakash Industries Limited  
Address : Srivan, Bijwasan,  
New Delhi -110 061, (India)  
Phone : +(91)-(11)-28062115,16  
Phone : +(91)-(11)-25305800  
Fax : +(91)-(11)-28062119  
Email : pilho@prakash.com

Sri Sapthagiri Polymers,  
(An ISO 9001:2008 Certified Company)  
Plot No. J19 & J20,  
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Perundurai – 638052,  
Erode Dt, Tamil nadu, India  
Phone: +91 80125 44225  
Email: info@maruthipvcpipes.com  
Email: maruthipvcpipes@gmail.com
PVC PIPE MANUFACTURERS/EXPORTERS
RAW MATERIAL SECTION

PVC RESIN:

Polyvinyl chloride (PVC) is one of the most important thermo-plastics in the world to-day.

Though polyvinyl chloride was made in the laboratory more than a century ago, commercial exploitation of the chemical came only in the 1930's especially with the discovery of plasticizer by B.F. Goodrich Chemical Co. U.S.A. because use of plasticizer made it possible to convert the otherwise horny and difficult materials viz. PVC into a workable plastic. Efforts during the second world war days for finding substitute for conventional materials like natural rubber, which were in short supply gave a boost for intensive research and development of various synthetic materials, especially polymers. In the process, plasticized PVC got considerable importance as the nearest substitute for rubber.
DIMENSION OF PVC PIPE

PVC Pipe & Fittings Dimensions (Sch 40 / Sch 80)

**Schedule 40 PVC Pipe Dimensions**

<table>
<thead>
<tr>
<th>Nom. Pipe Size (in)</th>
<th>O.D.</th>
<th>Average I.D.</th>
<th>Min. Wall</th>
<th>Nominal Wt./Ft.</th>
<th>Maximum W.P. PSI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>0.405</td>
<td>0.249</td>
<td>0.068</td>
<td>0.051</td>
<td>810</td>
</tr>
<tr>
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<td>0.344</td>
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<tr>
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<tr>
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<td>0.602</td>
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</tr>
<tr>
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## Schedule 80 PVC Pipe Dimensions

<table>
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<tr>
<th>Nominal Pipe Size (in)</th>
<th>O.D.</th>
<th>Average I.D.</th>
<th>Min. Wall</th>
<th>Nominal Wt./lt.</th>
<th>Maximum W.P. PSI*</th>
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<td>18.000</td>
<td>16.014</td>
<td>0.937</td>
<td>36.487</td>
<td>220</td>
</tr>
<tr>
<td>20</td>
<td>20.000</td>
<td>17.814</td>
<td>1.031</td>
<td>44.648</td>
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<tr>
<td>24</td>
<td>24.000</td>
<td>21.418</td>
<td>1.218</td>
<td>63.341</td>
<td>210</td>
</tr>
</tbody>
</table>
# FORMULATION FOR PVC RIGID PIPES

## Formulation - I

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PVC</td>
<td>100</td>
</tr>
<tr>
<td>2. DIOP &amp; DAP</td>
<td>42</td>
</tr>
<tr>
<td>3. Lead Stearate</td>
<td>3</td>
</tr>
<tr>
<td>4. Calcium Stearate</td>
<td>1</td>
</tr>
<tr>
<td>5. Mineral Precipitated Calcium carbonate</td>
<td>2.5</td>
</tr>
<tr>
<td>6. Colour</td>
<td>1.5</td>
</tr>
</tbody>
</table>

## PVC FLEXIBLE PIPES (Agricultural Pipes)

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC resin (K - value 70)</td>
<td>100</td>
</tr>
<tr>
<td>Dioctyl Phthalate</td>
<td>40</td>
</tr>
<tr>
<td>Chlorinated Paraffin wax</td>
<td>5</td>
</tr>
<tr>
<td>Ba - Cd liquid Stabilizer</td>
<td>3</td>
</tr>
<tr>
<td>Stearic Acid</td>
<td>1</td>
</tr>
<tr>
<td>Colors &amp; Dyes</td>
<td>0.2</td>
</tr>
</tbody>
</table>
**Process of Manufacture**

(1) Compounding PVC and other ingredients.
(2) Extrusion Forming.
(3) Sizing of Extruded Pipe.
(4) Cooling of Pipe in cooling bath.
(5) Pulling of Pipe.
(6) Cutting to length or winding in coil form.

PVC compounds is prepared by mixing in a high speed mixer after which the mix is fed into the extruder for forming pipe. The flexible PVC pipes is processed at 170°C to 190°C. The same extruder can be used for different size of pipes. The flexible pipe is pulled out of the die and cooled with chilled water in the cooling tank by the haul off unit. The cooling tank is continuously circulated with cold water to cool the processed pipes.

The hoses formed are Cvt into specific lengths, depending upon the requirement by a cutting device. The product is rolled by a winding machine.

### PLUMBING PIPES

<table>
<thead>
<tr>
<th>O.D. (mm)</th>
<th>Min</th>
<th>Well thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>2.8</td>
<td>3.3</td>
</tr>
<tr>
<td>25</td>
<td>2.9</td>
<td>3.4</td>
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<tr>
<td>32</td>
<td>3.4</td>
<td>3.9</td>
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<td>40</td>
<td>3.6</td>
<td>4.2</td>
</tr>
<tr>
<td>50</td>
<td>3.7</td>
<td>4.3</td>
</tr>
</tbody>
</table>
USES & APPLICABILITY OF PVC COMPOUNDS

To-day among various thermoplastics, PVC occupies a front line with respect to its utility and diversity of applications. This is due to remarkable and unique versatility of PVC. From the basic polymer to the working formulation which contains other chemical and additives, one has a large spectrum of choice to tailor the material to suit any specific and use. Thus PVC finds applications in almost all the major areas of importance in the human society following are some of the important in the human society.

Following are some of the important applications of PVC compound and its formulations.

**Building and construction:**

PVC pipes for water supply, pressure pipes, for DWV roofing, wall covering hand rails, sidings, claddings floor tiles, water stopps, door and windows frames, swimming pool liners, weather stripings etc. Wires and cables conduits, plugs and sockets, other electrical accessories and fittings.

**Packaging:**

Film for shrink wrapping, socks and liners, bottles and containers, sachets pouches for toiletries, blister packs and vacuum forming, closure liners and gaskets.

**Miscellaneous:-**

Rain wear goods, peneties, refrigerator door liners, book covers and stationary supplies tools and hardware, coating for protection and decorative purpose, battery separators etc.
MANUFACTURING PROCESS OF PVC PIPES

The plastic raw materials required to obtain desired product properties are mixed and heated. Depending on the raw material mix, the melting process requires a temperature of approx 200°C. The material mix is heated in an extender when the presses the hot moldable plastic mass through a die to shape the pipes. The calibrator in the casing head is adjusted to the desired pipe diameter. Pipe accessories are shaped in molds from the heated raw materials.

After shaping, the pipes are cooled and hardened or a water bath. The continuous pipe string is then cut to the desired length.

PVC pipes are created by starting with a molten mixture of the material and shaping them around a cast. The casts are made to be the exact width of the pipe. The mixture is poured into a cast and surrounded by an outer shell. The complete set is then placed into an oven to be cooked. Once the pipe has solidified, it is cooled and moved into finishing. Sections of the pipe are then cut based on common sizes and needs. The sections are then coated in a chlorine solution to prevent harmful bacteria from growing during shipping and use. Once the coating is dried, the ends of each section are finished. If the pipe is a smooth connection, the top of the pipe is sanded down to ensure a perfectly flat surface. For fitted pipes, a machine engraves a series of grooves into the pipe. As the grooves are cut, high-pressured water is sprayed on the pipe to remove excess PVC fragments. After the grooves are added, the ends are smooth and the sections are sent into testing.

Because PVC pipes are used in many housing and commercial construction applications, it is important that each pipe is tested to ensure quality. To do so, the pipes are tested for their seal, connection (on grooved sections), and strength. The seal tests are conducted by adding special cement to the pipe and allowing it to dry. Once this is complete, a series of liquids are passed through the pipe at high pressure. If no leaks occur, the cement is removed and the section is cleaned. For fitted pipes, a similar process takes place without the cement. The final test of the pipes is to ensure their strength. This is completed by using several presses that push weight down on the pipe. If the section does not break or show stress points, it is sent for packaging and shipping. If a section fails at any point in the process, it is sent back to be melted down and re-constructed."
PROCESS OF MANUFACTURE OF RIGID PIPES

Rigid or unplasticized PVC pipes are made from polyvinyl chloride (PVC) which in resin form is hard and rigid material. This rigidity can be controlled by controlling the percentage of plasticizer at the time of compounding. The production of rigid PVC pipes consists of plasticizing and homogenizing PVC compound and metering through and extruder. This hot molten PVC compound is extruded by the extruder through a circular slit. This circular slit governs the size of the pipe to be extruded. Different dies are used for manufacturing different sizes of pipes.

The pipe thus extruded through the die is then passed through a vacuum sizing tank where the dimensions of the pipe can be accurately set. This also helps in the surface finish of the pipe. Vacuum sizing which is more sophisticated than other types of forming operations reduces the percentage of wastage considerably.

TWIN SCREW EXTRUDERS

The various design changes for the counter rotating intermeshing Twin Screw Extruders, which are predominantly used for the processing of PVC powder mixed are as follows:

- Introduction of modular construction systems for entire type series.
- Increasing of barrel lengths.
- Increasing of the screw speed range,
- Increasing the torque for the screws.
- Improved drives and reduction gears,
- Reliable long life radial load bearings for the screw drive shafts with improved axial load bearings (cylindrical roller bearings in single and random arrangement).
Metallurgically optimized steel alloys for screws and barrels with special heat treatment, partly with surface protection coatings also.

The outstanding processing developments in respect of twin screw extruders are:

Introduction and improvements of barrele venting.

Lengthening of screws and thereby more clearly defined energy transfer,

Improved temperature control systems for screws a barrels,

Introduction of mixing zones of screws,

Use of polyolefin’s in powder form with fillers.

**EXTRUSION DIES**

The compilation of numerous computer programmes to assist design calculations for melt flow channels has been a decisive contribution towards the development of extrusion dies.

Calculations and practical values permits the manufacture of dies independent of melt viscosities. The application range of one extrusion die is increased so that various thermoplastics resins at high output rates can be extruded without losing their requirements for uniformity and dimensional precision.

As far as calculation is concerned, the consideration of the extruder and die as one unit has become of increasing importance in order to calculate output rates more precisely.

Extrusion dies used for the co extrusion process have kept their unchanged position compared to the adopter technology. The dominating use concerning the extrusion of different melt viscosities at various output rates is obvious.
EXTRUSION LINES:-

The extrusion line passes through very different steps of development dependent on the product quality and the thermoplastic resin to be processed.

In general, an extrusion line can be divided into three operation section, to evaluate and to determine these section parameters with their limit values influencing the product quality.

a) Extrusion section:

Feeding of the materials, extruder with auxiliary equipments.

b) Melt forming section:

Die head and sizing die.

c) Conversion into the final product:

Cooling and calibrating units, transport, cutting and stacking.

In recent years, there was an increased use of measurement and control technology. Additionally the advanced penetration by micro-electronics results in the application of specified process control systems.

In this respect, a main selection criteria is the acceptable price/performance relationship between the additional costs involved and the improvement in technique achieved in combination with the rate of product quality improved. Therefore the automation system has to match the particular plant type and desired degree of automation.

As the pipe being extruded is rigid in form they cannot be wound into coils, so as in line motorized cutting device should be provided for cutting the pipes into required sizes.
Since the performance requirement for the rigid pipes are quite critical the unit should preferably be equipped with process control laboratory for the preliminary testing of raw materials for ascertaining the consistency in their quality. The unit may also have arrangement for quality testing of pipes. Details of testing equipment have been given under machinery and equipments.

**PVC PIPE FITTINGS:**

For manufacturing same procedure is applied as in the case of pipe manufacture. Fittings are manufactured by using different dies made for different kinds of fittings. These dies are fitted on the moulding machine and molten PVC is charged in them. The dies are removed and the produced form is removed and the die is again set on the moulding machine. The same process is repeated.

Elbows and T-joints are manufactured using elbow moulding machine in which molten PVC is charged in the die and compressed air is injected in the die to get the desired product.
PLASTICIZER OF PVC

Plasticizers are used to modify the hardness of unplasticized PVC so as to produce flexible products. The main points to consider while selecting plasticizers are: compatibility, solvating characteristics, permanence efficiency and economy.

If the solvating rate of plasticizer is higher, the fusion temperature of the compound is lower. But plasticizers with high solvating rate do not necessarily have higher compatibility e.g. BBp has very high solvating rate but lower compatibility as compared to DOP.

Simple diester plasticizers like DOP do not present heat stability problems. Phosphate plasticizers like TCP increase flame resistance but decreases the heat stability of product. Higher than normal epoxy and stabilizer level are required while using phosphate plasticizers.
FILLERS OF PVC

Fillers are added in PVC compound to reduce the latter’s cost. While adding fillers care should be taken to add about 0.1 part extra lubricants with every 8 parts of fillers. Activated calcium carbonate, calcium silicate and whiting are the most commonly used fillers at present for the manufacture of PVC leather cloth, industrial sheets and flexible sheets.
STABILIZERS

Stabilizers are added to PVC compound to prevent discoloration during processing and to maintain product properties during service life. Stabilizers do not prevent degradation process. The function of stabilizer in PVC compound is very important because even if 0.01 per cent of the total PVC degrades, the entire color of the compound or product may become black.

There are over 2,000 stabilizers available for use in PVC compounding and practically all are manufactured in India. Regardless of their large number, the stabilizers can be grouped according to their chemical composition and use into (a) lead compounds (b) organotin compounds (c) barium-cadmiums (d) stabilizers for non-toxicity (e) epoxy compounds, and (f) UV stabilizers etc.
PROCESS FLOW SHEET FOR THE MANUFACTURE OF PVCPIPES

PVC RESIN → MIXER → EXTRUSION → COOLING & CUTTING

INGREDIENTS

SCRAP GRINDER

P.V.C. PIPEES OF 4.5mm THICKNESS

INSPECTION & TESTING

PACKING & STORAGE
PROCESS FLOW SHEET FOR THE MANUFACTURE OF PVC FITTINGS

PVC RESIN → MIXER → INJECTION MOULDING M/C → PHYSICAL INSPECTION & TESTING OF FILLING

INGREDIENTS (OTHERS)
MANUFACTURING PROCESS
OF PVC & CPVC PIPE FITTING

PVC and CPVC pipe fitting are made on the injection moulding machine. The PVC & CPVC Compounds are fed into the hopper of the injection moulding machine which essentially has a mould locking and injection arrangements. The mould is held in between the platens, which are kept closed by the locking pressure and the materials, which get plasticized by the heating arrangements, is injected under this pressure into moulds which result, into a moulded and high quality product. Mould should have proper injection arrangement for consistent high production.
DETAILS OF PLASTIC EXTRUSION PROCESS

Extrusion is a high volume manufacturing process in which raw material is melted and formed into a continuous profile. The plastic extrusion process is a well known technique, widely used in the polymerization industry. In the plastic extrusion, raw thermoplastic material, in the form of small beads is fed from a top mounted hopper into the barrel of the extruder. Additives such as colorants and UV inhibitors (either liquid or pellet form) are often used and can be mixed into the resin prior arriving into the hopper. The material enters through the feed throat (an opening near the rear of the barrel) and comes in contact with the screw.

The rotating screw is normally tuned up to 120 rpm and forces the plastic beads to move forward into the barrel. It is heated to the desired melting temperature of the molten plastic depending on range from 50°C to 250°C of the polymer. The raw thermoplastic material is fed into the hopper in the form of solid pellet passes through the temperature zones and it is heated and melted. The melted polymer material is pushed forward by a powerful screw and then passes through the molding mechanism to form the die.
Extruder Heater

An extrusion barrel in such a process usually consists of several temperature zones controlled by many electrical heaters with appropriate power specifications which influence each other and hence, the performance is limited. The extrusion system consists of three heating stages, in which the first is a barrel zone that has eight heaters and uses a ceramic heater. The second one is adapter zone, placed next to barrel zone. It has a single heater. The last heating stage is the die zone and uses six asbestos heaters.

The power specifications of these heaters are different. The temperature stability in the plastic extrusion machine is the major role of the controller.

In order to extrude certain materials, the temperature along the extruder must be accurately controlled in accordance with the properties of the particular polymer and the extruder. If the temperature is not accurately controlled, it will result to excessive temperature and the molten polymer will not be uniform and decompose. These controllers are designed with a high sensitivity to disturbance signal.
Block Diagram of the Plastic Extrusion Plant
Temperature Section of PVC Plant
# Heater Specification of Plastic Extrusion System

<table>
<thead>
<tr>
<th>Zone &amp; No. of Heaters</th>
<th>Diameter of Heater (Cm)</th>
<th>Power consumed (Watts)</th>
<th>Voltage (Volts)</th>
<th>Temperature (Celsius)</th>
<th>Current (Ampere)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrel zone 1 &amp; 3 Heaters</td>
<td>170</td>
<td>2100</td>
<td>240</td>
<td>190</td>
<td>10</td>
</tr>
<tr>
<td>Barrel zone 2 &amp; 3 Heaters</td>
<td>170</td>
<td>2500</td>
<td>240</td>
<td>188</td>
<td>9</td>
</tr>
<tr>
<td>Barrel zone 3 &amp; 1 Heater</td>
<td>250</td>
<td>1500</td>
<td>240</td>
<td>175</td>
<td>6</td>
</tr>
<tr>
<td>Barrel zone 4 &amp; 1 Heater</td>
<td>250</td>
<td>1300</td>
<td>240</td>
<td>168</td>
<td>5</td>
</tr>
<tr>
<td>Adapter zone &amp; 1 Heater</td>
<td>125</td>
<td>500</td>
<td>240</td>
<td>175</td>
<td>2</td>
</tr>
<tr>
<td>Die zone 1 &amp; 1 Heater</td>
<td>330</td>
<td>1800</td>
<td>240</td>
<td>170</td>
<td>2</td>
</tr>
<tr>
<td>Die zone 2 &amp; 1 Heater</td>
<td>450</td>
<td>3300</td>
<td>240</td>
<td>172</td>
<td>1.5</td>
</tr>
<tr>
<td>Die zone 3 &amp; 1 Heater</td>
<td>450</td>
<td>3800</td>
<td>240</td>
<td>175</td>
<td>2</td>
</tr>
<tr>
<td>Die zone 4 &amp; 1 Heater</td>
<td>450</td>
<td>3300</td>
<td>240</td>
<td>180</td>
<td>1.5</td>
</tr>
<tr>
<td>Die zone 5 &amp; 1 Heater</td>
<td>250</td>
<td>2200</td>
<td>240</td>
<td>188</td>
<td>2</td>
</tr>
<tr>
<td>Die zone 6 &amp; 1 Heater</td>
<td>250</td>
<td>2200</td>
<td>240</td>
<td>188</td>
<td>1.5</td>
</tr>
</tbody>
</table>
In the temperature response control, if the temperature rises rapidly and precisely, stable value will be required in stable state mode. The temperature system has non-linearity, long delay time, large time constant and undetermined system. The difficult task of modelling and controlling is complex in real world system, especially, when implementation issues are considered. The conventional controllers require restrictive assumptions to design the plant model. The assumptions are not taken into account and it may result in a number of unknown variables that the controller design techniques will be unable to handle. This is the reason, the process of industry machines, human, have lack of ability to solve the problems using imprecise information.

Over the years, control of process system plants in the industry is customarily done by experts through the conventional control techniques. This is due to its simplicity, low cost design and robust performance in a wide range of operating conditions. Different types of polymer will have different screw designs. In most processes, a heating profile is set for the barrel, in which three or more independent conventional controlled heater zones gradually increase the temperature of the barrel from the rear (where the plastic enters) to the front.

This allows the plastic beads to melt gradually, as they are pushed through the barrel and lowers the risk of overheating avoids degradation in the polymer. Extra heat is contributed by the intense pressure and the friction takes place inside the barrel. In fact, if an extrusion line is able to run certain material fast enough, then the heaters can be shut off and the melting temperature is maintained only by pressure and friction inside the barrel.

In most extruders, if too much heat is generated, cooling fans are present to keep the temperature below a set value. If forced air cooling proves insufficient and then cast in heater jackets are employed, and they generally use a closed loop of distilled water in heat exchange with cooling tower. At the front of the barrel, the molten plastic leaves the screw and travels through a screen pack to remove any contaminants in the melt. Since the pressure at this point exceeds 5000 PSI, screens are reinforced by a breaker plate (a thick metal puck with many holes drilled through it). The screen pack and breaker plate assembly also serves to create back pressure in the barrel. Back pressure is required for uniform melting and proper mixing of the polymer.
The pressure generated can be changed by varying screen pack composition either by changing the number of screens or by adjusting wire weave size or also by changing other parameters. The function of converting rotational of the molten plastic into longitudinal memory is done by breaker plate and screen pack combination. After passing through the breaker plate, molten plastic enters the die.

The die gives the final product. The die profile must be designed effectively such that the molten plastic evenly flows from a cylindrical profile to the profile shape of the product. Uneven flow at this stage would produce the product with unwanted stresses at certain points in the profile. These stresses can cause warping upon cooling. Almost any imaginable shape can be created so long as it is a continuous profile. The product must now be cooled and this is usually achieved by pulling the extrudate through a water bath.

Plastic is a very good thermal insulator and therefore it is difficult to cool quickly. When compared with the conduction of heat in plastic it is 2000 times much slower than steel. In a plastic extrusion line, a sealed water bath is acted upon by a carefully controlled vacuum to keep the newly formed and still molten tube or pipe from collapsing. Once the product is cooled, it can be spooled, or cut into desired length for further use.

**Plastic Extrusion Screw**

The screw design is an important factor to produce a quality product. Different types of polymer will have different screw designs.
Often the screw length, when it is referenced to its diameter is given by L: D ratio. For instance, a 6-inch (150 mm) diameter screw at 24:1 will be 144 inches (12 ft) long, and at 32:1 it is 192 inches (16 ft) long. An L: D ratio of 24:1 is common, but at the same screw diameter in some machines goes upto 32:1 for more mixing and more output. Two-stage (vented) screws are typically 36:1 to account for the two extra zones. Depending on the number of heaters used for controlling the temperature, each zone is equipped with one or more thermocouples. The flow of heat from one stage to another causes bad transient response for the heating process under set point and load variation is not indicated with the papers. The varying parameters and the system complexity and the need of mathematical model are the problem of the PID controllers.

The PID controllers are with more transient state at the time of set point changes because the plastic extruder is with more set point temperatures and take more time to stable in the set point temperature.
DETAILS OF INJECTION MOLDING FOR PIPE FITTINGS

Injection molding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection molding, which vary greatly in their size, complexity, and application. The injection molding process requires the use of an injection molding machine, raw plastic material, and a mold. The plastic is melted in the injection molding machine and then injected into the mold, where it cools and solidifies into the final part.
Process Cycle

The process cycle for injection molding is very short, typically between 2 seconds and 2 minutes, and consists of the following four stages:

1. **Clamping** - Prior to the injection of the material into the mold, the two halves of the mold must first be securely closed by the clamping unit. Each half of the mold is attached to the injection molding machine and one half is allowed to slide. The hydraulically powered clamping unit pushes the mold halves together and exerts sufficient force to keep the mold securely closed while the material is injected. The time required to close and clamp the mold is dependent upon the machine - larger machines (those with greater clamping forces) will require more time. This time can be estimated from the dry cycle time of the machine.

2. **Injection** - The raw plastic material, usually in the form of pellets, is fed into the injection molding machine, and advanced towards the mold by the injection unit. During this process, the material is melted by heat and pressure. The molten plastic is then injected into the mold very quickly and the buildup of pressure packs and holds the material. The amount of material that is injected is referred to as the shot. The injection time is difficult to calculate accurately due to the complex and changing flow of the molten plastic into the mold. However, the injection time can be estimated by the shot volume, injection pressure, and injection power.

3. **Cooling** - The molten plastic that is inside the mold begins to cool as soon as it makes contact with the interior mold surfaces. As the plastic cools, it will solidify into the shape of the desired part. However, during cooling some shrinkage of the part may occur. The packing of material in the injection stage allows additional material to flow into the mold and reduce the amount of visible shrinkage. The mold cannot be opened until the required cooling time has elapsed. The cooling time can be estimated from several thermodynamic properties of the plastic and the maximum wall thickness of the part.
4. **Ejection** - After sufficient time has passed, the cooled part may be ejected from the mold by the ejection system, which is attached to the rear half of the mold. When the mold is opened, a mechanism is used to push the part out of the mold. Force must be applied to eject the part because during cooling the part shrinks and adheres to the mold. In order to facilitate the ejection of the part, a mold release agent can be sprayed onto the surfaces of the mold cavity prior to injection of the material. The time that is required to open the mold and eject the part can be estimated from the dry cycle time of the machine and should include time for the part to fall free of the mold. Once the part is ejected, the mold can be clamped shut for the next shot to be injected.

After the injection molding cycle, some post processing is typically required. During cooling, the material in the channels of the mold will solidify attached to the part. This excess material, along with any flash that has occurred, must be trimmed from the part, typically by using cutters. For some types of material, such as thermoplastics, the scrap material that results from this trimming can be recycled by being placed into a plastic grinder, also called regrind machines or granulators, which regrinds the scrap material into pellets. Due to some degradation of the material properties, the regrind must be mixed with raw material in the proper regrind ratio to be reused in the injection molding process.

**Equipment**

Injection molding machines have many components and are available in different configurations, including a horizontal configuration and a vertical configuration. However, regardless of their design, all injection molding machines utilize a power source, injection unit, mold assembly, and clamping unit to perform the four stages of the process cycle.
Injection unit

The injection unit is responsible for both heating and injecting the material into the mold. The first part of this unit is the hopper, a large container into which the raw plastic is poured. The hopper has an open bottom, which allows the material to feed into the barrel. The barrel contains the mechanism for heating and injecting the material into the mold. This mechanism is usually a ram injector or a reciprocating screw. A ram injector forces the material forward through a heated section with a ram or plunger that is usually hydraulically powered. Today, the more common technique is the use of a reciprocating screw. A reciprocating screw moves the material forward by both rotating and sliding axially, being powered by either a hydraulic or electric motor. The material enters the grooves of the screw from the hopper and is advanced towards the mold as the screw rotates. While it is advanced, the material is melted by pressure, friction, and additional heaters that surround the reciprocating screw. The molten plastic is then injected very quickly into the mold through the nozzle at the end of the barrel by the buildup of pressure and the forward action of the screw. This increasing pressure allows the material to be packed and forcibly held in the mold. Once the material has solidified inside the mold, the screw can retract and fill with more material for the next shot.

Injection molding machine - Injection unit
Clamping unit

Prior to the injection of the molten plastic into the mold, the two halves of the mold must first be securely closed by the clamping unit. When the mold is attached to the injection molding machine, each half is fixed to a large plate, called a platen. The front half of the mold, called the mold cavity, is mounted to a stationary platen and aligns with the nozzle of the injection unit. The rear half of the mold, called the mold core, is mounted to a movable platen, which slides along the tie bars. The hydraulically powered clamping motor actuates clamping bars that push the moveable platen towards the stationary platen and exert sufficient force to keep the mold securely closed while the material is injected and subsequently cools. After the required cooling time, the mold is then opened by the clamping motor. An ejection system, which is attached to the rear half of the mold, is actuated by the ejector bar and pushes the solidified part out of the open cavity.

Injection molding machine - Clamping unit
Machine specifications

Injection molding machines are typically characterized by the tonnage of the clamp force they provide. The required clamp force is determined by the projected area of the parts in the mold and the pressure with which the material is injected. Therefore, a larger part will require a larger clamping force. Also, certain materials that require high injection pressures may require higher tonnage machines. The size of the part must also comply with other machine specifications, such as shot capacity, clamp stroke, minimum mold thickness, and platen size.

Injection molded parts can vary greatly in size and therefore require these measures to cover a very large range. As a result, injection molding machines are designed to each accommodate a small range of this larger spectrum of values. Sample specifications are shown below for three different models (Babyplast, Powerline, and Maxima) of injection molding machine that are manufactured by Cincinnati Milacron.
Tooling

The injection molding process uses molds, typically made of steel or aluminum, as the custom tooling. The mold has many components, but can be split into two halves. Each half is attached inside the injection molding machine and the rear half is allowed to slide so that the mold can be opened and closed along the mold's parting line. The two main components of the mold are the mold core and the mold cavity. When the mold is closed, the space between the mold core and the mold cavity forms the part cavity, that will be filled with molten plastic to create the desired part. Multiple-cavity molds are sometimes used, in which the two mold halves form several identical part cavities.
**Mold base**

The mold core and mold cavity are each mounted to the mold base, which is then fixed to the platens inside the injection molding machine. The front half of the mold base includes a support plate, to which the mold cavity is attached, the sprue bushing, into which the material will flow from the nozzle, and a locating ring, in order to align the mold base with the nozzle. The rear half of the mold base includes the ejection system, to which the mold core is attached, and a support plate. When the clamping unit separates the mold halves, the ejector bar actuates the ejection system. The ejector bar pushes the ejector plate forward inside the ejector box, which in turn pushes the ejector pins into the molded part. The ejector pins push the solidified part out of the open mold cavity.
Mold channels

In order for the molten plastic to flow into the mold cavities, several channels are integrated into the mold design. First, the molten plastic enters the mold through the sprue. Additional channels, called runners, carry the molten plastic from the sprue to all of the cavities that must be filled. At the end of each runner, the molten plastic enters the cavity through a gate which directs the flow. The molten plastic that solidifies inside these runners is attached to the part and must be separated after the part has been ejected from the mold. However, sometimes hot runner systems are used which independently heat the channels, allowing the contained material to be melted and detached from the part. Another type of channel that is built into the mold is cooling channels. These channels allow water to flow through the mold walls, adjacent to the cavity, and cool the molten plastic.
Mold design

In addition to runners and gates, there are many other design issues that must be considered in the design of the molds. Firstly, the mold must allow the molten plastic to flow easily into all of the cavities. Equally important is the removal of the solidified part from the mold, so a draft angle must be applied to the mold walls. The design of the mold must also accommodate any complex features on the part, such as undercuts or threads, which will require additional mold pieces. Most of these devices slide into the part cavity through the side of the mold, and are therefore known as slides, or side-actions. The most common type of side-action is a side-core which enables an external undercut to be molded. Other devices enter through the end of the mold along the parting direction, such as internal core lifters, which can form an internal undercut. To mold threads into the part, an unscrewing device is needed, which can rotate out of the mold after the threads have been formed.
Mold - Exploded view
THE NEW GENERATION OF PVC-O PIPES

Molecular Orientation, a revolution in PVC Technology

PVC-O pipes are the most advanced pipes for the conveyance of high-pressure water currently available on the market, with a number of exceptional features for this kind of application, thanks to the process of molecular orientation.

PVC is essentially an amorphous polymer in which the molecules are located randomly. However, under certain conditions of pressure, temperature and speed, by stretching the material, it is possible to orient the polymer molecules in the same direction as which the material has been stretched.

Depending on the process parameters used and mostly strech ratio, a higher or lower orientation degree will be obtained. The result is a plastic with a layered structure which layers can be seen at a glance.

The molecular orientation process modifies the PVC’s structure by giving the polymer’s molecules a linear orientation.
A PLASTIC WITH UNBEATABLE PROPERTIES

The process of molecular orientation greatly enhances PVC’s physical and mechanical properties and gives it a number of exceptional features, without altering the advantages and properties of the original polymer. This makes for a plastic with unbeatable qualities in terms of resistance to traction and fatigue, flexibility and impact resistance.

When used in high-pressure water pipelines this type of piping has a high resistance and an extremely long lifetime. Moreover, the pipe is highly energy-efficient and eco-friendly not only for the way it is made but also because of its subsequent use. Other advantages include reductions in costs and installation times.

For all these reasons, PVC-O pipes are the best solution for medium and high pressure water networks for irrigation systems, potable water supply, fire extinguishing networks and pumping systems, among other applications.

Cutting-edge technology for water

Up until now, although PVC-O pipes are recognized as providing the highest specifications, the technical limitations of the different manufacturing processes and the shortcomings of those processes in terms of efficiency were a barrier to the extensive use of this kind of pipes.

The technology developed by MOLECOR means that these limitations have now been overcome and it has also helped to make considerable improvements in PVC pipes.

- Molecular Orientation is achieved by applying the precise and homogenous distribution of temperature and high pressures (up to 35 bars) thanks to quality control checks carried out on each individual pipe and throughout the entire manufacturing process.

- The PVC pipes manufacturing process is continuous and fully-automated (as opposed to the traditional discontinuous method), providing greater control over the end product and ensuring the uniform quality of each pipe.
Maximum reliability and Security

- **Maximum Molecular Orientation:** Class 500, according to the ISO 16422:2006 Standard, the highest orientation degree offering the best mechanical properties.

- Greater reliability of the end product.

- Strict dimensional tolerances.

- Homogeneous behavior of the materials used.

- Reinforced socket, shaped during the orientation process.

The best choice for high-pressure fluid transport

Unbeatable Impact Resistance

PVC pipes have a high resistance to shock. This means that are minimized breakages during installation or during on-site trials caused by dropping or by impacts from stones.

Furthermore, Molecular Orientation prevents the propagation of cracks and scratches and eliminates the risk of rapid crack behaviour. The result is a spectacular increase in the product’s useful life.

High short and long term hydrostatic resistance

PVC pipes offer a resistance to internal pressure of up to two times the nominal pressure (32 bars in PN16 bar pipes or 400 psi in PN 200 psi), which means that they can bear sporadic excessive pressure such as water hammers and other malfunctions in the network. Moreover, the material creep behavior is very low, ensuring the durability of the pipe working at nominal pressure for over a hundred years.
Excellent response to water hammer

PVC pipes offer lower celerity than other piping systems (four times less than ductile iron pipes), which means less water hammers caused by sudden variations in water volume and pressure. This reduces and almost eliminates the possibility of breakage during opening and closing in the water network and when pumping gets under way, protecting every component of the network.

Increase Hydraulic capacity

Molecular Orientation reduces the pipe wall thickness, giving PVC pipes a greater internal diameter and flow section. Also, the internal surface is extremely smooth, reducing load loss and making it more difficult for deposits to be formed on the inner walls. As a result, PVC pipes offer between 15% - 40% more hydraulic capacity than pipes made from other materials and with the same external dimensions.

Maximum Flexibility

Thanks to their excellent elasticity, PVC pipes can bear deformation of up to 100 percent of their internal diameter. When crushed, or in the event of a mechanical accident, PVC pipe immediately goes back to its original shape, thus minimizing the risk of potential breakage by soil subsidence or sharp edges on rocks or machinery, for example. And thanks to their considerable capacity for bearing heavy loads, PVC pipes ensure optimum performance once laid underground.

Complete Corrosion Resistance

Oriented PVC is immune to corrosion and to natural chemical substances, as well as to aggression from micro- and macroorganisms. PVC pipes, therefore, are not degradable. Moreover, they do not require any type of special protection or coating, which means costsavings.
Total Water Quality

The quality of the fluid that circulates in PVC pipes will always remain unaltered, given that the material neither suffers corrosion nor migrations within the pipes or in their coating. Mandatory tests such as those made according to the Spanish Law, RD 140/2003 and RD 866/2008, have been made and show that the excellent qualities of these pipes comply with the required health standards for water for human consumption, along with the list of materials and plastic objects made in order to be in contact with food. Also PVC pipe has the ACS (Sanitary Certification) according French legislation. Consequently, PVC pipes are considered the best application for high pressure water transport, particularly drinking water, for water supply networks.

Completely Water Tight

Joints are 100 percent watertight and are guaranteed not to displace once the pipes have been installed. PVC pipes are easy to join and can be installed by lower-qualified workers.

Lower Cost and Easier Installation

PVC-O pipes are lighter and easier to handle than other pipes made from other materials: in most cases, handling does not require machinery. What’s more, due to the easiness union, flexibility and impact resistance, they make a positive stand out in terms of cost, performance and installation speed compared to other pipes.
The most eco-friendly pipes on the market

Energy efficient

The exceptional mechanical properties of these pipes mean considerable savings in raw materials:

- For the same external nominal diameter, PVC requires less PVC because the pipe wall is thinner.
- Petrol consumption required for manufacture is lower than in other plastic solutions.
- Similarly, PVC energy consumption in the manufacturing process is lower than in other PVC-O pipes, and unlike metal pipes manufacturing, it does not require high energy expenses.

The inner wall of PVC pipes is extremely smooth, keeping load loss down to a minimum, so the energy required for the powered transporting of fluids is also lower. Throughout their entire lifecycle, PVC pipes avoid the unnecessary use of considerable amounts of energy resources and reduce CO2 emissions.

Optimal Use of Water Resources

Thanks to their long useful life and optimum water-tightness –not only in normal operating conditions, but also in the event of accidents in the flow network or on the site where they are laid–, PVC pipes are the best ally for the rational use of water resources.

Water supply networks that used traditional materials are currently registering a leakage rate of up to 25 percent of channeled water, and the latter's chemical deterioration means that some water conduits are currently being replaced despite having been laid only a few years ago. Infrastructures created with PVC piping are a tool for managing water resources for generations to come.

100% Recyclable

PVC products are 100 percent recyclable: they can be ground and reprocessed for reuse in the manufacture of other plastic products.
Energy consumed by pipes (raw materials + manufacture) (kWh)

Energy consumed by raw materials (kWh)

Energy consumed in manufacturing (kWh)

Energy consumed by pumping (kWh)
The best mechanical properties

Tensile Resistance

In terms of performance, PVC-O shows a very different stress-strain curve when compared conventional plastics and comes very close to the curve of metals.

Mechanical properties complete transformation of PVC-O compared to conventional PVC can only be achieved in the higher class PVC-O class 500.
**Long Term Hydrostatic Resistance**

Materials lose their mechanical properties when they are subjected to strain over a long period of time. This characteristic, known as creep, appears to a far lesser extent in PVC-O 500 than in conventional plastics, which means better properties over the long term. Bearing in mind that PVC-O is exceptionally resistant to fatigue and has a very good chemical resistance, in common with conventional PVC, it is no exaggeration to say that this kind of piping is capable of withstanding the pressures of work for over a hundred years.
Piping and Material Mechanical Properties

<table>
<thead>
<tr>
<th>Product Standard</th>
<th>Units</th>
<th>TOM° PVC-O 500</th>
<th>PVC</th>
<th>HDPE-100</th>
<th>HDPE-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum required strength (MRS)</td>
<td>MPa</td>
<td>50.0</td>
<td>25.0</td>
<td>10.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Overall service coefficient (C)</td>
<td>[]</td>
<td>1.4</td>
<td>2.0</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>Design Stress (σ)</td>
<td>MPa</td>
<td>36.0</td>
<td>12.5</td>
<td>8.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Short-term elasticity modulus (E)</td>
<td>MPa</td>
<td>&gt; 4,000</td>
<td>&gt; 3,000</td>
<td>1,100</td>
<td>900</td>
</tr>
<tr>
<td>Resistance to axial traction</td>
<td>MPa</td>
<td>&gt; 48</td>
<td>&gt; 48</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Resistance to tangential traction</td>
<td>MPa</td>
<td>&gt; 90</td>
<td>&gt; 48</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Shore Hardness D</td>
<td>[]</td>
<td>81 - 85</td>
<td>70 - 85</td>
<td>60</td>
<td>65</td>
</tr>
</tbody>
</table>

(1) For pipes with a DN ≥ 110.

Other Material Characteristics

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>UNITS</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Kg/dm³</td>
<td>1.35 - 1.46&lt;sup&gt;(1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>PVC Resin k value</td>
<td>[]</td>
<td>&gt; 64</td>
</tr>
<tr>
<td>Shore Hardness D at 20° C</td>
<td>[]</td>
<td>81 – 85</td>
</tr>
<tr>
<td>Poisson Coefficient</td>
<td>[]</td>
<td>0.35 - 0.41</td>
</tr>
<tr>
<td>Vicat Temperature</td>
<td>°C</td>
<td>&gt; 80</td>
</tr>
<tr>
<td>Lineal expansion coefficient</td>
<td>°C&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>0.8 x 10&lt;sup&gt;-4&lt;/sup&gt;</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>Kcal/mh°C</td>
<td>0.14 - 0.18</td>
</tr>
<tr>
<td>Specific heat at 20° C</td>
<td>cal/°C</td>
<td>0.20 - 0.28</td>
</tr>
<tr>
<td>Dielectric stiffness</td>
<td>Kv/mm</td>
<td>20 – 40</td>
</tr>
<tr>
<td>Dielectric constant at 60 Hz</td>
<td>[]</td>
<td>3.2 - 3.6</td>
</tr>
<tr>
<td>Transverse resistivity at 20° C</td>
<td>Ω/cm</td>
<td>&gt; 10&lt;sup&gt;16&lt;/sup&gt;</td>
</tr>
<tr>
<td>Absolute roughness (kα)</td>
<td>mm</td>
<td>0.007</td>
</tr>
<tr>
<td>Absolute roughness (Hazen Williams)</td>
<td>[]</td>
<td>150</td>
</tr>
<tr>
<td>Manning Roughness Coefficient</td>
<td>[]</td>
<td>0.009</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Although the standard allowance includes this range, TOM° PVC-O pipe is between 1.39 and 1.43 kg/dm³.
UNBEATABLE HYDRAULIC PROPERTIES

Hydraulic Capacity

Comparison of hydraulic capacity: TOM© PVC-O PN16 pipes vs other materials (constant load loss)

Using pipes with a lower hydraulic capacity involves necessarily using a larger nominal diameter, which has a negative effect on both profitability and infrastructure investment costs. Using TOM© means you get more hydraulic capacity for your investment costs.
Water Hammer

Water hammers occur when liquid flowing through piping stops suddenly when a valve is open or closed, if a pump is stopped or started or by airlocks shifting within the pipe. Water hammers can place greater pressure on a pipe’s working pressure and lead to breakage, particularly when the pipe has already been damaged by impacts or corrosion.

Water hammers (P) depend on the celerity (a), which is the wave speed, and the fluid’s change of speed (V) The celerity depends basically on the pipe’s dimensions (the relationship between the external diameter and the minimum thickness) and the specifications of the material with which the tube is made (Young’s E module).

\[
P = \frac{a \cdot V}{g}; \quad a = \frac{1420}{\sqrt{1 + \left(\frac{h}{E}\right)^2 \left( \frac{D_t}{e_{\text{min}}} - 2 \right)}}
\]

PVC-O pipes have a significantly lower celerity than pipes made from other materials, particularly so with metal piping.

A range for all kinds of applications

Dimension

<table>
<thead>
<tr>
<th>Nominal Diameter (DN)</th>
<th>Outside Diameter (OD)</th>
<th>Inside Diameter (ID)</th>
<th>Wall Thickness (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>90</td>
<td>90.0</td>
<td>84.0</td>
<td>2.0</td>
</tr>
<tr>
<td>110</td>
<td>110.0</td>
<td>100.0</td>
<td>2.2</td>
</tr>
<tr>
<td>140</td>
<td>140.0</td>
<td>125.0</td>
<td>2.8</td>
</tr>
<tr>
<td>160</td>
<td>160.0</td>
<td>150.0</td>
<td>3.2</td>
</tr>
<tr>
<td>200</td>
<td>200.0</td>
<td>175.0</td>
<td>3.8</td>
</tr>
<tr>
<td>225</td>
<td>225.0</td>
<td>195.0</td>
<td>4.5</td>
</tr>
<tr>
<td>250</td>
<td>250.0</td>
<td>210.0</td>
<td>5.0</td>
</tr>
<tr>
<td>315</td>
<td>315.0</td>
<td>260.0</td>
<td>6.3</td>
</tr>
<tr>
<td>400</td>
<td>400.0</td>
<td>290.0</td>
<td>6.3</td>
</tr>
<tr>
<td>500</td>
<td>500.0</td>
<td>320.0</td>
<td>7.6</td>
</tr>
<tr>
<td>630</td>
<td>630.0</td>
<td>390.0</td>
<td>8.8</td>
</tr>
</tbody>
</table>
PVC-O pipes are supplied in total lengths of 6 metres (socket included). For other lengths for special projects, price on request. Dimensions in inches are approximately.

Packaging

<table>
<thead>
<tr>
<th>DN mm</th>
<th>PIPES/PALLETS</th>
<th>PALLETS/TRUCK</th>
<th>PIPES/TRUCK</th>
<th>METERS TRUCK</th>
<th>WIDTH PALLETS (mm)</th>
<th>KG/PALLETS PN16</th>
<th>KG/PALLETS PN20</th>
<th>KG/PALLETS PN25</th>
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<tbody>
<tr>
<td>90</td>
<td>69</td>
<td>16</td>
<td>1104</td>
<td>6624</td>
<td>1200</td>
<td>540</td>
<td>550</td>
<td>670</td>
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<tr>
<td>110</td>
<td>76</td>
<td>12</td>
<td>912</td>
<td>5472</td>
<td>1200</td>
<td>750</td>
<td>790</td>
<td>980</td>
</tr>
<tr>
<td>140</td>
<td>39</td>
<td>12</td>
<td>468</td>
<td>2808</td>
<td>1100</td>
<td>610</td>
<td>650</td>
<td>800</td>
</tr>
<tr>
<td>160</td>
<td>28</td>
<td>12</td>
<td>336</td>
<td>2016</td>
<td>1100</td>
<td>560</td>
<td>610</td>
<td>760</td>
</tr>
<tr>
<td>200</td>
<td>18</td>
<td>12</td>
<td>216</td>
<td>1296</td>
<td>1100</td>
<td>540</td>
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<tr>
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<td>132</td>
<td>792</td>
<td>1050</td>
<td>450</td>
<td>610</td>
<td>600</td>
</tr>
<tr>
<td>250</td>
<td>11</td>
<td>12</td>
<td>132</td>
<td>792</td>
<td>1100</td>
<td>510</td>
<td>590</td>
<td>730</td>
</tr>
<tr>
<td>315</td>
<td>13</td>
<td>8</td>
<td>92-104</td>
<td>546-624</td>
<td>2300</td>
<td>960</td>
<td>1100</td>
<td>1350</td>
</tr>
<tr>
<td>400</td>
<td>9</td>
<td>6</td>
<td>54</td>
<td>324</td>
<td>2100</td>
<td>1070</td>
<td>1250</td>
<td>1500</td>
</tr>
<tr>
<td>500</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>192</td>
<td>2300</td>
<td>750</td>
<td>900</td>
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<tr>
<td>630</td>
<td>3</td>
<td>6</td>
<td>18</td>
<td>108</td>
<td>1900</td>
<td>900</td>
<td>1050</td>
<td>1250</td>
</tr>
</tbody>
</table>
Joints and Water tight Seals

TOM© PVC-O pipes use the sector’s most reputable seal for high pressure drinking water pipes: the Anger-LockTM, by Trelleborg Forsheda Pipe Seals. The seal comprises a PP ring and a synthetic rubber lip that is an integrated part of the pipe, avoiding displacement from its setting or movement when installation is taking place.
Fittings

Tapping Saddles

Allow connecting the pipe in the perpendicular direction to all kinds of fittings (house connections, valves, purges, vents, etc. They are available with screws ends and flange ends.
FLANGE WITH ANTI-TRACTION SYSTEM

Allows connecting the spigot ends to all kinds of fittings with connection to a flange (valves, elbows, t’s, DN reductions, caps, etc).
FITTINGS WITH PLUGS EURO TYPE

Connected directly with the pipe allow to have deviations, reductions and connections on the net (elbows, t’s, DN reductions, etc).

Applications

Conduits for potable water transport. It is included both water abstraction and water distribution network to city centers, urban network and industrial areas, and water transfer to tanks and reservoirs. Pipelines for transport of water that have been treated to remove impurities. Water transport pipes for irrigation purposes. It includes irrigated land pipelines, water transfer to tanks and reservoirs.

OTHER APPLICATIONS

Sewage
Fire Protection Nets
Industrial Applications
Infrastructural Nets
PLANT LAYOUT

Raw Material storage
500 sq.mt.

Processing Area
2000 sq.mt.

Finished Product storage
500 sq.mt.

Administrative Building
200 sq.mt.

Testing Lab
100 sq.mt.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Xxxx  GREEN PATCH  xxxx
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Toilet

OUT GATE

Parking

IN GATE

Security Guard Room

Total Land Area = 2 Acre (8000 sq.mt.)
SUPPLIERS OF PLANT AND MACHINERY

Uponor Infra Oy, Technology
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Email: machinery.vaasa@uponor.com
www.uponor.com/technology

Krauss Maffei Berstorff GmbH.
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Fax: +49 (0) 511561916
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fax +39 0544 81340
info@sica-italy.com
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Fax: +49 (0) 2129 941699
Email: michael.kalthoff@plama.de
Internet: www.plama.de

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Fax: +91 – 79 – 25842059, 25842145
Email: sales.emd@windsormachines.com

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Fax: +39 030 2592028
Email: sales.imm@windsormachines.com
MOULDS FOR PIPE FITTINGS

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Gokhiware, Walive Road, Vasai (east),
Dist. Thane, Mumbai, Maharashtra, India
Pin Code: 401208
Phone: +91-250-2458866
Mobile: +91-9820614605, +91-9820003337
Web Site: http://www.shreejimoulds.co.in
Web Page: https://www.exportersindia.com/shreejimoulds

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unityplastomech@gmail.com

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info@vrundavanengg.com
vandanaplast@yahoo.com
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S. K. Engineers  
Naved Ahmed (Managing Director)  
102, Garden City, Opposite HDFC Bank,  
Pawan Vihar Colony Gate Near Akash Tower,  
Almadina Hospital, Bisalpur Chouraha,  
University Road, Bareilly - 243005,  
Uttar Pradesh, India  
Mobile: +91-9412292815, +91-8755011715

Hindustan Plastic And Machine Corporation  
Amit Kalra (CEO)  
No. 5, Category II, DSIDC, Industrial Area,  
Nangloi, New Delhi - 110041, Delhi, India  
Mobile: +(91) - 9911423376, (91) - 9891061200  
Phone: +(91) - (11) - 22171114

Rd Engineering Works,  
Sanjeev Dhiman (Manager)  
J - 2848, DSIDC Industrial Park,  
Narela, Delhi - 110040, , India  
Mobile: +91-9899119350, +91-9811016823  
Telephone: +91-11-22171154, +91-11-22854513  
Fax: +91-11-22854513
Archana Extrusion Machinery Manufacturing
Kalpesh Gajjar (Proprietor)
No. 7, Kansawala Estate,
Opposite Chakudiya Mahadev,
Rakhial, Ahmedabad - 380023, Gujarat, India
Mobile: 91-9825157891, +91-9712956891
Telephone: +91-79-22745089

Dharam Engineering Works
Rajan Gogna (CEO)
Mr. Rajan Gogna
A- 142, Wazirpur Industrial Area,
New Delhi - 110052, Delhi, India
Mobile: +91-9891468647, +91-9312250313
Telephone: +91-11-47087645

S.K. Industries
102, Garden City,
Opp. HDFC Bank,
Pawan Vihar Colony Gate,
Near Akash Towar-Almadina Hospital Bisalpur Chouraha,
University Road, Bareilly (U.P.) 243005 INDIA
PHONE NO+91-8755011715 / +91- 9412292815 / +91-9319414137 / +91-8410085551
EMAIL: skengineersbly@gmail.com
www.smallscaleindustries.in
HIGH SPEED MIXER

Navdurga Engineers
No. 82, Panchratna Industrial Estate,
Behind Zaveri Estate, Singrva Kathwada Road,
Kathwada, Ahmedabad - 382430, Gujarat, India
Mobile: +(91)-9879541422, +(91)-9426344688
Telephone: +(91)-(79)-65411422

Europack Machines (India) Pvt. Ltd.,
No. 14, Bindal Estate, Sakinaka
Mumbai - 400072, Maharashtra, India
Mobile: +(91)-9323249260, +(91)-8655023415
Telephone: +(91)-(22)-28502151

Archana Extrusion Machinery Manufacturing
No. 7, Kansawala Estate, Opposite Chakudiya Mahadev,
Rakhial, Ahmedabad - 380023, Gujarat, India
Mobile: +(91)-9979856891, +(91)-9825157891
Telephone: +(91)-(79)-22745089
Fax: +(91)-(79)-25626375

Sant Engineering Industries
No. 580, Main Faiz Road, Street No.17,
Karol Bagh, New Delhi - 110005, Delhi, India
Mobile: +(91)-9717263888, +(91)-9868107361
Telephone: +(91)-(11)-23521090, +(91)-(11)-23679498
R.k. Plasto Machines
No. 281/A, Sector- F, Sanwer Road, Industrial Area
Indore - 452 001, Madhya Pradesh, India
Mobile: +(91)-9826422591, +(91)-9826057069
Telephone: +(91)-(731)-2422591, +(91)-(731)-2722841

Shini Plastics Technologies India Private Limited
1A-46, Chakan Industrial Area, Phase 11,
Vasuli Village, Chakan Taluka Khed
Pune - 410501, Maharashtra, India
Mobile: +(91)-9594906911
Telephone: +(91)-(2135)-660616

V. I. P. Engineers
C/59, Zaveri Industrial Estate, Kathvada Road,
Opposite ShyamVilla Society, Singrva Kathvada Cross Road,
Kathvada, Ahmedabad - 382430, Gujarat, India
Mobile: +(91)-9426755612, +(91)-9879274168

Gajjar Engineering & Fabrication Works
No. 163, Pushkar Industrial Estate, Opposite Macon Industry,
G. I. D. C., Phase- 1, Vatva, Ahmedabad - 382445, Gujarat, India
Mobile: +(91)-9924798685, +(91)-8460440508
Telephone: +(91)-(79)-40328765
EXTRUDER

Dynamtech Engineers
No. 214, Palsikar Colony
Indore, Madhya Pradesh- 452007, ( India )
Contact Person : Mr. Manohar Mirchandani
E-mail : business@dynamtechengineers.com, ravimir@yahoo.com
Mobile : +(91)-9893078979/9907277277
Phone : +(91)-(731)-2364890/2761418
Fax : +(91)-(731)-4036004

Odtin Food Solution Pvt. Ltd.
Plot no. 1916, Scheme no. 114 (Part-I),
Indore (MP), INDIA. PIN–452010
Works : 27/1 Mahak Market Talawali Chanda
Indore (MP), INDIA. PIN–452010
Email Id : odtinfoods@yahoo.com, shekhar@odtin.biz, enquiry@odtin.biz
Contact No. : (+91) 7879560415, 9993020831

Suan Scientific Instruments & Equipments
P - 814, Ground Floor, Block-A, Lake Town
Kolkata - 700089, West Bengal, India
Mobile: +(91)-9903872341, +(91)-8017463132, +(91)-9433263575
Telephone: +(91)-(33)-25342047
Fax: +(91)-(33)-25213743

Koyka Electronics Pvt. Ltd.
F 121, Tirkha Colony, Tigaon Road,
Ballabgarh, Faridabad - 121006, Haryana, India
Mobile: +(91)-9810501205
Telephone: +(91)-(129)-2210991
Fax: +(91)-(129)-4062533, +(91)-(129)-4063206
Email: harsh@koykagroup.co.in, sales@koykagroup.co.in
PLASTIC SCRAP GRINDER MACHINE

Anantha Naayaki Enterprises
No. 4, Thamarai Street, Selliamman Koil Nagar, Athipet, Chennai - 600058, Tamil Nadu, India
Mobile: +(91)-9500064115, +(91)-8939741971

Gajjar Engineering & Fabrication Works
No. 163, Pushkar Industrial Estate,
Opposite Macon Industry, G. I. D. C., Phase- 1,
Vatva, Ahmedabad - 382445, Gujarat, India
Mobile: +(91)-9924798685, +(91)-8460440508
Telephone: +(91)-(79)-40328765

N. K. Industries
No. 44, Kameshwar Estate, Phase- 4, G. I. D. C.,
Vatva, Ahmedabad - 382445, Gujarat, India
Mobile: +(91)-9727720246, +(91)-9887631082
Telephone: +(91)-(79)-40087095, +(91)-(79)-25841423

Mayur Industries
MSSIDC Compound, Plot No. D-10, Road No. 30,
Wagle Industrial Estate, Thane West, Thane - 400604,
Maharashtra, India
Mobile: +(91)-7738044641, +(91)-9892654641
Telephone: +(91)-(22)-25834641

A. V. S. Plastic
No. 360, Chandra Prabhu Vegetarian Village,
Gandhi Road, Puzhal, Chennai - 600066,
Tamil Nadu, India
Mobile: +(91)-9444055598, +(91)-9383055598
Star Machines India
Ram Rahim Compound, Shanti Nagar,
A. K. Road, Safed Pool, Sakinaka
Mumbai - 400072, Maharashtra, India
Mobile: +(91)-9821234984
Telephone: +(91)-(22)-28521628

Vacuum Tech Machines
Samitha Complex, Unit No. 18, Gala No. 01,
Ground Floor, Behind MTNL Exchange, A-K Road,
Sakinaka, Mumbai - 400072, Maharashtra, India
Mobile: +(91)-9821247886, +(91)-9702960358

Europack Machines (India) Pvt. Ltd.
No. 14, Bindal Estate, Sakinaka
Mumbai - 400072, Maharashtra, India
Mobile: +(91)-9323249260, +(91)-8655023415
Telephone: +(91)-(22)-28502151

Din Engineering Works
No. 8, Union Industrial, Near Gujarat Bottling,
Rakhial, Ahmedabad - 380023, Gujarat, India
Mobile: +(91)-9879519340
Telephone: +(91)-(79)-22748269

Micro Machinery Manufacturers
Vasant Patel/ Shailesh Patel
Survey No. 30/ 1, Plot No. B- 2,
Behind Ganga Forging, Shapar Veraval
Rajkot - 360024, Gujarat, India
Mobile: +(91)-9898899884, +(91)-9426242519
Telephone: +(91)-(2827)-254426
Fax: +(91)-(2827)-296183
PLASTIC INJECTION MOULDING MACHINE

Ghanshyam Engineering Co.
No. 12, Samrat Industrial Area,
Behind S.T. Workshop, Gokuldham Road
Rajkot - 360004, Gujarat, India
Mobile: +(91)-9825293732, +(91)-9825020210
Telephone: +(91)-(281)-2360283

Kashyap Industries
61, Gajanand Industrial Estate,
Near Nagarwel Hanuman Temple,
Opposite Gujarat Bottling, Rakhial
Ahmedabad - 380023, Gujarat, India
Mobile: +(91)-9879580713, +(91)-9974010321, +(91)-9638990197
Telephone: +(91)-(79)-22740713

Natraj Industries
Plot No. 564, Kathwada G I.D.C.,
Opposite Road No. 10,
Near Tribhuvan Estate Gate,
Phase-2, Kathwada, Tal- Daskroi
Ahmedabad - 382430, Gujarat, India
Mobile: +(91)-9909421763, +(91)-9376105240, +(91)-9825404666
Email: info@natrajind.com, mahesh@natrajind.com, sales@natrajind.com

Nebula Hydraulic Services
Plot No. 44, Bileshwar Estate, Part-1,
Opposite Gujarat Vepari Mahamandal,
Odhav- Kathwada Road, Ring Road, Odhav
Ahmedabad - 382415, Gujarat, India
Mobile: +(91)-9824095698, +(91)-9924066698
Telephone: +(91)-(79)-22901922
Fax: +(91)-(79)-22901921
GENERATOR SET

Shachi Engineering Private Limited
Gat No. 271, A/PO Bhare, Tal. Pirangut,
District, Pune - 411 001, Maharashtra, India
Phone: +(91)-(20)-66546900
Website: www.shachiindia.com/

Ganpati Electricals (P) Ltd
U- 110, 1st Floor, Surya Arcade,
Main Vikas Marg, Shakarpur,
New Delhi - 110092, Delhi, India
Phone: +(91)-(11)-22466869 / 65385144
Website: www.ganpatielectricals.com/diesel-generator-sets.html

Ra Powergen Engineers Private Limited
53, 3rd Floor, Shree Chambers, Subbaram Chetty Road,
Netkalappa Circle, Bengaluru - 560 004, Karnataka, India
Phone: +(91)-(80)-26622769 / 26622848 / 26622849 / 26622850
Fax: +(91)-(80)-26622766

Brilltech Engineers Private Limited
D-113, Sector 10, Noida - 201 301,
Uttar Pradesh, India
Phone: +(91)-(120)-4227251 / 4572252
Fax: +(91)-(120)-4572002
Website: www.brilltechglobal.com/generator-set.html

Ravi Kiran Industries
No. 213, Mittal Estate, No. 2, Marol Naka,
Andheri East, Mumbai - 400 059, Maharashtra, India
Phone: +(91)-(22)-28506569 / 28597856 / 28506135
Fax: +(91)-(22)-28506135
Website: www.pharmamachinerymanufacturers.com/injectable-solution-machines.html
KVK Corporation  
A-1, Trishul, Mahakali Caves Road, Andheri (East),  
Mumbai - 400 093, Maharashtra, India  
Phone: +(91)-(22)-28342439 / 28363569  
Fax: +(91)-(22)-28375432  
Website: www.kvkcorporation.com/dissolved-acetylene-gas-plant.html

Nelion Exports  
No. 105, Champaklal Industrial Estate, Unit - 304,  
3rd Floor, Sion East, Mumbai - 400022,  
Maharashtra, India  
Phone: +(91)-(22)-24083436 / 24085676  
Fax: +(91)-(22)-24090406  
Website: www.nelionexports.com/electrical-accessories.html

Tachometric Controls  
S. No. 50/10/12, Near Abhiruchi Industrial Estate,  
Post Narhe, Tal - Haveli, Pune - 411 041,  
Maharashtra, India  
Phone: +(91)-(20)-24391385  
Website: www.tachometric.net/electronic-products.html

Asian Diesel Corporation  
B-79, Works Center, DSIDC Comlpex,  
Kalyanpuri, Delhi - 110 091, Delhi, India  
Phone: +(91)-(11)-22725153 / 22783052  
Fax: +(91)-(11)-22725153

Ozone Technologies  
C - 223, Sector - 63, Noida - 201305,  
Uttar Pradesh, India  
Phone: +(91)-(120)-4227679 / 4325073  
Fax: +(91)-(120)-4259442  
Website: www.creativeozone.com/industrial-ozone-generators.html
Goldstar Instrumentation
WZ-523/28A, Basai Darapur, Near Bali Nagar, Raja Garden, New Delhi - 110 015, Delhi, India
Phone: +(91)-(11)-25930536 / 25414789
Fax: +(91)-(11)-25423327

M/s Global Power Corporation
Shop no. 1, 8/16, Sector-3, Rajendra Nagar, Sahibabad, Ghaziabad - 201 005, Uttar Pradesh, India
Phone: +(91)-(120)-6523437
Fax: +(91)-(120)-4573437
Website: www.globalpowercorporation.com/

Eskay Engineering System
No. 484-C, NH-47, Airport Road, Opposite Suguna Kalyana, Mandapam, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India
Phone: +(91)-(422)-6532890 / 4397495
Website: www.eskaycarwashers.com/air-compressors.html

Sony Systems
C-153, Sector-10, Noida - 201 301, Uttar Pradesh, India
Phone: +(91)-(120)-2547899 / 3262845
Fax: +(91)-(120)-4223899
Website: www.laundryequipmentsindia.com/turnkey-projects-machines.html
SUPPLIERS OF RAW MATERIALS

PVC RESIN

Tarang Exports P Ltd
Rk Poddaar (Director)
117, Jolly Bhavan-1, New Marine Lines
Mumbai - 400020, Maharashtra, India
Mobile: +(91)-976900033, +(91)-8879003200
Telephone: +(91)-(22)-66512700, +(91)-(22)-66518094

Fine Flow Plastic Industries
Amrish Aggarwal (Partner)
No. 301, Almar Arcade, Marve Road,
Orlem, Above Punjab National Bank,
Near Borivali Briyani Centre, Malad (West)
Mumbai - 400064, Maharashtra, India
Mobile: +(91)-9892951218, +(91)-9321012301
Telephone: +(91)-(22)-28650970, +(91)-(22)-28650977

Aditya Molecules
401/C, Hetal Arch Premises
Opposite Natraj Market, Malad West
Mumbai - 400064, Maharashtra, India
Mobile: +(91)-9987132089
Telephone: +(91)-(22)-28806344, 28805863

Jai Enterprises
Office No. 300, Building No. H- 2,
Apra North Extension Plaza,
Netaji Subhash Place, Pitampura
New Delhi - 110034, Delhi, India
Mobile: +(91)-9811610823, 9811610973
Telephone: +(91)-(11)-45596775, +(91)-(11)-65800980
CALCIUM STEARATE

Lumega Industries
Ramesh Mehendale (Proprietor)
Lumega Industries, Flat No. 401/402 4th Floor,
Jeevan Deep Building, Baburao Parulekar Marg,
Off Gokhale Road S, Dadar West, Mumbai - 400028,
Maharashtra, India
Mobile: +(91)-9820963816
Telephone: +(91)-(22)-24363008

Eklingjee Polymers Private Limited
Ashish Aggarwal (Director)
27/14, 2nd Floor, Nangia Park, Shakti Nagar.
Nearest Metro Is Vishviwadlya, Subhash Nagar,
Delhi, India
Mobile: +91-9310691474, +91-9910233904
Fax: +91-11-23936365

Remedy Labs
Hemant Joshi (CEO)
Plot No. 260, Phase - I, G. I. D. C.,
Naroda, Ahmedabad - 382330, Gujarat, India
Mobile: +91-9825060087, +91-9375060087
Telephone: +91-79-22810517, +91-79-40080087

Global Medicines Limited
Mukesh Vaswani
N. H. 8, Near Gutal Crossing Gutal-
Uttarsanda Road, Uttarsanda,
Nadiad - 387370, Gujarat, India
Mobile: +91-9824041895, 91-9377445454
Telephone: +91-268-2588066, +91-268-2588606
Fax: +91-268-2588606
LEAD STEARATE

Eklingjee Polymers Private Limited
Ashish Aggarwal (Director)
27/14, 2nd Floor, Nangia Park,
Shakti Nagar. Nearest Metro Is Vishvivadlya,
Subhash Nagar, Delhi - , India
Mobile: +91-9310691474, +91-9910233904
Fax: +91-11-23936365

Jai Enterprises
Himanshu Aggarwal
Office No. 300, Building No. H- 2,
Apra North Extension Plaza,
Netaji Subhash Place, Pitampura,
New Delhi - 110034, Delhi, India
Mobile: +91-9811610823, +91-9811610973
Telephone: +91-11-45596775
Fax: +91-11-45596775

Styro Chemical Industries
Nitin Maheshwari (Owner)
Works 280 Chhapraula Gb Nagar,
Office E-132 Shastri Nagar Merrut,
Ghaziabad - 201301, Uttar Pradesh, India
Mobile: +91-9808172830, +91-9897686470

Pocl Enterprises Limited
Y. V. Raman (Director - Marketing)
New No.4, Old No.319, Valluvarkottam High Road,
2nd Floor, Nungambakkam, Nungambakkam High Road,
Chennai - 600034, Tamil Nadu, India
Mobile: +91-9884231431
Telephone: +91-44-49145454, +91-44-28251418
Fax: +91-44-49145455
PRECIPITATED CALCIUM CARBONATE

Gangotri Inorganic (p) Ltd.
Rajesh Tiwari(Director)
Mr. Archit Pokar
No. 311, Anand Mangal- 1,
Behind Femina Town Near Stadium Circle,
C. G. Road, Navrangpura, Ahmedabad - 380009,
Gujarat, India
Mobile: +91-9725738888, +91-9898237777
Telephone: +91-79-30026789, +91-79-40077772

Lime Chemicals Limited
Rahim Dawoodani (Director)
Neco Chamber Premises Cooperative Society Limited,
Off. No. 404/405, 4th Floor, Plot No. 48 Sector- 11,
C.B.D. Belapur, Navi Mumbai - 400614, Maharashtra, India
Mobile: +91-9820849869, +91-9891499004
Telephone: +91-22-27561977, +91-22-27561980

Suday Minerals & Chemicals Private Limited
Gopal Agrawal (Managing Director)
T-5, Panoramic Apartment, Fatehsagar Road,
Dewali, Udaipur - 313001, Rajasthan, India
Mobile: +(91)-9829044395, +(91)-9414157615
Telephone: +(91)-(294)-2451615, +(91)-(294)-2650267

Kunal Calcium Limited
Puneet Nayyar (CEO)
SCO-17-20F, Dav Market, Opposite Madhu Hotel
Yamunanagar - 135001, Haryana, India
Mobile: +(91)-9896391205, +(91)-8800208822
Telephone: +(91)-(1732)-222797, +(91)-(1732)-235797
Fax: +(91)-(1732)-222796

www.eiriindia.org
PIGMENT DYE

Kolorjet Chemicals Pvt Ltd.
B/5, Raj Ratan Industrial Estate,
Next To American Spring,
Liberty Garden Road, Malad West
Mumbai - 400064, Maharashtra, India
Mobile: +(91) - 9920645611, +(91) - 9867650609
Phone: +(91) - (22) - 28826803, +(91) - (22) - 28826795

A. B. Enterprises
Manoharlal Bang (Partner)
No. 202, Shradanand Building,
No. 272/ 274, Samuel Street,
Mumbai - 400003, Maharashtra, India
Mobile: +(91)-9892424605, +(91)-9869434794
Telephone: +(91)-(22)-23435097, +(91)-(22)-66312586

Nitin Dye Chem Pvt. Ltd.
Mukesh Parekh (Marketing)
Plot No. 195, Phase II,
GIDC Estate, Vapi - 396195, Gujarat, India
Mobile: +(91)-9820369520
Telephone: +(91)-(22)-24083334, +(91)-(22)-24035006
Fax: +(91)-(22)-24083672

Khatau Valabhdas & Company
No. 142, D. N. Road, No. 102,
First Floor, Indian Globe Chambers,
Opposite McDonald, C.S.T.,
Mumbai - 400001, Maharashtra, India
Mobile: +91-9322507259, +91-9821223508
Telephone: +91-22-22611655, +91-22-22611656
PLANT ECONOMICS

Rated Plant capacity = 13.00 MT/day
= 3900.00 MT/annum

PVC & CPVC PIPES & FITTINGS

Basis

No. of working days = 25 days/month
= 300 days/annum

No. of shifts = 3 per day

One shift = 8 hours

4000 Kgs/Day = PVC Pipe
4000 Kgs/Day = CPVC Pipes
2500 Kgs/Day = PVC Pipes Fitt
2500 Kgs/Day = CPVC Pipes Fitt

Currency = Rs.
LAND & BUILDING

1. Land area 2 Acres (8000 sq.mtrs) on lease
2. Processing area 2000 sq.mtrs
   @Rs. 10,000/-sq.mtrs.  Rs. 2,00,00,000.00
3. Raw material storage 500 sq.mtrs.
   @Rs. 8,000/-sq.mtrs.  Rs. 40,00,000.00
4. Finished Product storage 500 sq.mtr
   @Rs. 8,000/-sq.mtrs.  Rs. 40,00,000.00
5. Testing Lab 100 sq.mtrs.
   @Rs. 10,000/-sq.mtrs.  Rs. 10,00,000.00
6. Administrative Building 200 sq.mtrs
   @Rs. 10,000/-sq.mtrs.  Rs. 20,00,000.00
7. Misc. Boundary wall, Gate etc.
   Rs. 10,00,000.00

-------------------------------
TOTAL  Rs. 3,20,00,000.00
-------------------------------
PLANT & MACHINERY

1. Twin screw CPVC pipe plant
   polymer used-CPVC Dry Blend
   Cap: 300 kg/hr consist of 66mm/30
   Dx2 Twin screw extruder, Diehead
   for CPVC (Double Exit), Set of Pin
   Bush and Calibrator, Vacuum sizing.
   Tank, Haul off unit, cutting saw
   unit, Tripping chute, Touch screen
   process control panel etc.
   Pipe Dia Range - 15-63mm
   1 No.   Rs.   1,00,00,000.00

2. Twin screw PVC pipe plant
   Polymer used-PVC Dry Blend Cap: 400 kg/hr
   consist of 66mm/30 L/D Ratio x 2
   Twin screw extender, Die head, Set
   of Pin, Bush and calibrator,
   Vacuum sizing tank, Haul off unit,
   cutting saw unit, Tripping chute,
   touch screw process control panel
   pipe Dia range - 63 to 200 mm
   1 No.   Rs.   80,00,000.00

3. Automatic Horizontal Injection
   Moulding Machine of shot capacity
   up to 500 gm with hydraulic pumps
   & Motor and Mould clamping force
   of 180 Metric Tons
   1 No.   Rs.   35,00,000.00

4. Chilling Plant
   1 No.   Rs.   10,00,000.00

5. Air Compressor
   1 No.   Rs.   3,00,000.00

6. High speed Compounding mixer
   1 No.   Rs.   8,00,000.00

7. Hopper Loader Cum Dryer
   1 No.   Rs.   3,00,000.00

8. Dies & Moulds (Assorted)
   Rs.   55,00,000.00
<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Handling Equipment</td>
<td>7,00,000.00</td>
</tr>
<tr>
<td>Scrap Grounder (18”)</td>
<td>1,00,000.00</td>
</tr>
<tr>
<td>D.G.Set 400 KVA</td>
<td>25,00,000.00</td>
</tr>
<tr>
<td>Laboratory Equipments</td>
<td>4,00,000.00</td>
</tr>
<tr>
<td>Hot Embossing Printing Machine 1 No.</td>
<td>7,00,000.00</td>
</tr>
<tr>
<td>Misc.pipes &amp; pipe fitting, Tools etc</td>
<td>10,00,000.00</td>
</tr>
</tbody>
</table>

**TOTAL**                                           **3,48,00,000.00**
OTHER FIXED ASSETS

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office equipment, furniture plus other equipment &amp; accessories</td>
<td>Rs. 5,00,000.00</td>
</tr>
<tr>
<td>Erection, Installation &amp; Electrification</td>
<td>Rs. 10,00,000.00</td>
</tr>
<tr>
<td>Consultancy &amp; Technical Know How</td>
<td>Rs. 5,00,000.00</td>
</tr>
<tr>
<td>Pre operative &amp; Preliminary Expenses</td>
<td>Rs. 3,00,000.00</td>
</tr>
<tr>
<td>Official Vehicle 2 Nos</td>
<td>Rs. 12,00,000.00</td>
</tr>
<tr>
<td>Misc.</td>
<td>Rs. 2,00,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>Rs. 37,00,000.00</strong></td>
</tr>
</tbody>
</table>
### FIXED CAPITAL

1. **LAND & BUILDING**  
   Rs. 3,20,00,000.00

2. **PLANT & MACHINERY**  
   Rs. 3,48,00,000.00

3. **OTHER FIXED ASSETS**  
   Rs. 37,00,000.00

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**TOTAL**  
Rs. 7,05,00,000.00
### PVC AND CPVC PIPE AND FITTINGS MFG. PLANT [EIRI/EDPR/3527] J.C.1613

#### J.C. 1613

---

**working capital requirement/month**

**raw materials**

1. PVC Compounded Granules 166MT  
   @Rs. 80,000/- Ton  
   Rs. 1,32,80,000.00

2. CPVC (Chlorinated Polyvinyl Chloride) Compound 166MT  
   @Rs. 1,50,000/- Ton  
   Rs. 2,49,00,000.00

3. Packaging materials & Misc. Consumables  
   Rs. 10,00,000.00

---

**total**  
Rs. 3,91,80,000.00
### SALARY & WAGES / MONTH

<table>
<thead>
<tr>
<th>Position</th>
<th>No.</th>
<th>Salary (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager Cum Technologist</td>
<td>1 No.</td>
<td>90,000.00</td>
</tr>
<tr>
<td>Shift Supervisors</td>
<td>3 No.</td>
<td>90,000.00</td>
</tr>
<tr>
<td>Chemist</td>
<td>1 No.</td>
<td>40,000.00</td>
</tr>
<tr>
<td>Assistant Chemist</td>
<td>1 No.</td>
<td>30,000.00</td>
</tr>
<tr>
<td>Skilled Workers</td>
<td>18 No.</td>
<td>3,24,000.00</td>
</tr>
<tr>
<td>Unskilled Workers</td>
<td>18 No.</td>
<td>2,52,000.00</td>
</tr>
<tr>
<td>Accountants</td>
<td>2 No.</td>
<td>50,000.00</td>
</tr>
<tr>
<td>Marketing Personnels</td>
<td>4 No.</td>
<td>1,20,000.00</td>
</tr>
<tr>
<td>Administrative Staffs</td>
<td>10 No.</td>
<td>2,00,000.00</td>
</tr>
<tr>
<td>Peon/Security Guards</td>
<td>12 No.</td>
<td>1,68,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>13,64,000.00</strong></td>
</tr>
</tbody>
</table>

Plus perks @ 33% p.a.

<table>
<thead>
<tr>
<th>Perks</th>
<th>Amount (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4,50,120.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18,14,120.00</strong></td>
</tr>
</tbody>
</table>
UTILITIES AND OVERHEADS

1. Power Consumption of 100000 Kwatt hrs @ Rs. 8.00 per Kwatt hr. Rs. 8,00,000.00
2. Water Consumption of 3000 KLs @ Rs. 5.00 per KL Rs. 15,000.00
3. Repair & Maintenance Rs. 1,00,000.00
4. Conveyance & Transportation Rs. 3,00,000.00
5. Advertisement & Publicity Rs. 2,00,000.00
6. Lease Rent Rs. 1,00,000.00
7. Administrative Expenses Rs. 2,00,000.00
8. Fuel for D.G.Set 5000 Ltrs @ Rs. 70/- Ltr Rs. 3,50,000.00
9. Misc. Rs. 80,000.00

------------------------
TOTAL Rs. 21,45,000.00
------------------------

Total load is 183 Kwatts
TOTAL WORKING CAPITAL/MONTH

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RAW MATERIAL</td>
<td>Rs. 3,91,80,000.00</td>
</tr>
<tr>
<td>2. SALARY &amp; WAGES</td>
<td>Rs. 18,14,120.00</td>
</tr>
<tr>
<td>3. UTILITIES &amp; OVERHEADS</td>
<td>Rs. 21,45,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Rs. 4,31,39,120.00</strong></td>
</tr>
</tbody>
</table>

1. WORKING CAPITAL FOR 3 MONTHS       | Rs. 12,94,17,360.00 |
2. MARGIN MONEY FOR W/C LOAN          | Rs. 3,23,54,340.00  |

COST OF PROJECT

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL FIXED CAPITAL</td>
<td>Rs. 7,05,00,000.00</td>
</tr>
<tr>
<td>MARGIN MONEY</td>
<td>Rs. 3,23,54,340.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Rs. 10,28,54,340.00</strong></td>
</tr>
<tr>
<td>Description</td>
<td>Amount</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>TOTAL FIXED CAPITAL</td>
<td>Rs. 7,05,00,000.00</td>
</tr>
<tr>
<td>TOTAL WORKING CAPITAL FOR 3 MONTHS</td>
<td>Rs. 12,94,17,360.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>Rs. 19,99,17,360.00</strong></td>
</tr>
</tbody>
</table>
PVC AND CPVC PIPE AND FITTINGS MFG. PLANT [EIRI/EDPR/3527] J.C.1613
J.C. 1613                                                     Page A- 12

COST OF PRODUCTION/ANNUM

1. Working Capital for 1 year          Rs. 51,76,69,440.00
2. Interest @ 13.50% on T.C.I          Rs. 2,69,88,843.61
3. Depreciation @ 10.00% on buildings  Rs. 32,00,000.00
4. Depreciation @ 20.00% on Plant and Machinery  Rs. 69,60,000.00
5. Depreciation @ 20.00% on office equipment & furnitures  Rs. 1,00,000.00

TOTAL                                   Rs. 55,49,18,283.62
PVC AND CPVC PIPE AND FITTINGS MFG.PLANT [EIRI/EDPR/3527] J.C.1613

TURN OVER/ANNUM

1. By sale of PVC pipes of different sizes 1200MT @Rs.1,20,000/-Ton (Avg) Rs.14,40,00,000.00

2. By sale of CPVC Pipes of different sizes 1200MT @Rs. 1,85,000/-Ton (Avg) Rs.22,20,00,000.00

3. By sale of PVC pipe fitting (Assorted) 750 MT @Rs. 1,30,000/-Ton (Avg) Rs. 9,75,00,000.00

4. By sale of CPVC pipe fitting (Assorted) 750 MT @Rs. 1,90,000/-Ton (Avg) Rs.14,25,00,000.00

------------------------
TOTAL                    Rs.60,60,00,000.00
PROFIT = RECEIPTS - COST OF PRODUCTION

= 60,60,00,000.00 - 55,49,18,283.62

= 5,10,81,716.38

PROFIT SALES RATIO = Profit / Sales x 100

\[
\frac{5,10,81,716.38}{60,60,00,000.00} \times 100
\]

= 8.43%

RATE OF RETURN = Operating profit / T.C.I x 100

\[
\frac{5,10,81,716.38}{19,99,17,360.00} \times 100
\]

= 25.55%
BREAK EVEN POINT (B.E.P)

Fixed Costs of the plant are as under

1. Interests Rs. 2,69,88,843.61
2. Depreciation Rs. 1,02,60,000.00
3. 40.00% of salaries Rs. 87,07,776.00
4. 40.00% of overheads Rs. 1,02,96,000.00

------------------------
TOTAL Rs. 5,62,52,619.62
------------------------

\[
\text{B.E.P.} = \frac{\text{Total fixed costs}}{\text{Total fixed costs + profit}} \times 100
\]

\[
= \frac{5,62,52,619.62}{5,62,52,619.62 + 5,10,81,716.38} \times 100
\]

= 52.41 %

LAND MAN RATIO = Total land / Manpower

0 : 70 :: 0 : 1
RESOURCES FOR FINANCE

1. Term loans from Financial institutions
   ( 65.00 % of fixed capital )
   at @13.50% p.a rate of interest  Rs. 4,58,25,000.05

2. Bank loans for 3 months
   ( 65.00 % of working capital )
   at @ 13.50% p.a rate of interest  Rs. 8,41,21,284.00

3. Self raised capital from even
   funds & loans from close ones to
   meet the margin money needs at a
   @ 13.50% p.a rate of interest  Rs. 6,99,71,076.02

--------------------------
TOTAL  Rs. 19,99,17,360.00
--------------------------
### Instalment Payable in 5 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>To Financial Institutions (Rs. 45825000)</th>
<th>To Commercial Banks (Rs. 84121284)</th>
<th>To Others (Rs. 69971076)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91,65,000.00</td>
<td>1,68,24,256.80</td>
<td>1,39,94,215.20</td>
<td>3,99,83,472.00</td>
</tr>
<tr>
<td>2</td>
<td>91,65,000.00</td>
<td>1,68,24,256.80</td>
<td>1,39,94,215.20</td>
<td>3,99,83,472.00</td>
</tr>
<tr>
<td>3</td>
<td>91,65,000.00</td>
<td>1,68,24,256.80</td>
<td>1,39,94,215.20</td>
<td>3,99,83,472.00</td>
</tr>
<tr>
<td>4</td>
<td>91,65,000.00</td>
<td>1,68,24,256.80</td>
<td>1,39,94,215.20</td>
<td>3,99,83,472.00</td>
</tr>
<tr>
<td>5</td>
<td>91,65,000.00</td>
<td>1,68,24,256.80</td>
<td>1,39,94,215.20</td>
<td>3,99,83,472.00</td>
</tr>
</tbody>
</table>

### Interest Payable in 5 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>On Term Loans (Rs. 45825000)</th>
<th>On Bank Loans (Rs. 84121284)</th>
<th>On Self Loans (Rs. 69971076)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61,86,375.00</td>
<td>1,13,56,373.34</td>
<td>94,46,095.26</td>
<td>2,69,88,843.61</td>
</tr>
<tr>
<td>2</td>
<td>49,49,100.00</td>
<td>90,85,098.67</td>
<td>75,56,876.21</td>
<td>2,15,91,074.89</td>
</tr>
<tr>
<td>3</td>
<td>37,11,825.00</td>
<td>68,13,824.00</td>
<td>56,67,657.16</td>
<td>1,61,93,306.17</td>
</tr>
<tr>
<td>4</td>
<td>24,74,550.00</td>
<td>45,42,549.34</td>
<td>37,78,438.11</td>
<td>1,07,95,537.44</td>
</tr>
<tr>
<td>5</td>
<td>12,37,275.00</td>
<td>22,71,274.67</td>
<td>18,89,219.05</td>
<td>53,97,768.72</td>
</tr>
</tbody>
</table>

### Total Repayment Schedule for 5 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Interest</th>
<th>Instalments</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,69,88,843.61</td>
<td>3,99,83,472.00</td>
<td>6,69,72,315.62</td>
</tr>
<tr>
<td>2</td>
<td>2,15,91,074.89</td>
<td>3,99,83,472.00</td>
<td>6,15,74,546.90</td>
</tr>
<tr>
<td>3</td>
<td>1,61,93,306.17</td>
<td>3,99,83,472.00</td>
<td>5,61,76,778.18</td>
</tr>
<tr>
<td>4</td>
<td>1,07,95,537.44</td>
<td>3,99,83,472.00</td>
<td>5,07,79,009.46</td>
</tr>
<tr>
<td>5</td>
<td>53,97,768.72</td>
<td>3,99,83,472.00</td>
<td>4,53,81,240.74</td>
</tr>
</tbody>
</table>
## DEPRECIATION CHART FOR 5 YEARS

<table>
<thead>
<tr>
<th>Year</th>
<th>Building costs (Rs. 32000000.00)</th>
<th>Plant &amp; Machinery (Rs. 34800000.00)</th>
<th>Fur. &amp; Office equip. (Rs. 500000.00)</th>
<th>Total @ 10.00 % P.A.</th>
<th>Total @ 20.00 % P.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32,00,000.00</td>
<td>69,60,000.00</td>
<td>1,00,000.00</td>
<td>1,02,60,000.00</td>
<td>2,10,80,000.00</td>
</tr>
<tr>
<td>2</td>
<td>28,80,000.00</td>
<td>55,68,000.00</td>
<td>80,000.00</td>
<td>85,28,000.00</td>
<td>1,70,56,000.00</td>
</tr>
<tr>
<td>3</td>
<td>25,92,000.00</td>
<td>44,54,400.00</td>
<td>64,000.00</td>
<td>71,10,400.00</td>
<td>1,42,20,800.00</td>
</tr>
<tr>
<td>4</td>
<td>23,32,800.00</td>
<td>35,63,520.00</td>
<td>51,200.00</td>
<td>59,17,520.00</td>
<td>1,18,35,040.00</td>
</tr>
<tr>
<td>5</td>
<td>20,99,520.00</td>
<td>28,50,816.00</td>
<td>40,960.00</td>
<td>49,91,296.00</td>
<td>99,82,592.00</td>
</tr>
</tbody>
</table>
### PROFIT ANALYSIS FOR 5 YEARS

<table>
<thead>
<tr>
<th>YR CAP. UTIL</th>
<th>Sales (after tax)</th>
<th>Mfg. Expenses</th>
<th>Gross Profit</th>
<th>Depreciation</th>
<th>Interest</th>
<th>Net profit before tax</th>
<th>Net profit after tax @ 35.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 70%</td>
<td>424200000</td>
<td>362368608</td>
<td>61831392</td>
<td>10260000</td>
<td>29988844</td>
<td>26285944</td>
<td>1597656</td>
</tr>
<tr>
<td>2 80%</td>
<td>484800000</td>
<td>414135552</td>
<td>70664448</td>
<td>8528000</td>
<td>21591075</td>
<td>48545373</td>
<td>26354493</td>
</tr>
<tr>
<td>3 80%</td>
<td>484800000</td>
<td>414135552</td>
<td>70664448</td>
<td>7110400</td>
<td>16193306</td>
<td>37362242</td>
<td>30784482</td>
</tr>
<tr>
<td>4 90%</td>
<td>545400000</td>
<td>465902496</td>
<td>79497504</td>
<td>5947520</td>
<td>10795537</td>
<td>62754447</td>
<td>40790390</td>
</tr>
<tr>
<td>5 100%</td>
<td>606000000</td>
<td>517669440</td>
<td>88330560</td>
<td>4991296</td>
<td>7941495</td>
<td>50661972</td>
<td>50661972</td>
</tr>
</tbody>
</table>

### CASH FLOW STATEMENT FOR 5 YEARS

<table>
<thead>
<tr>
<th>YR CAP. UTIL</th>
<th>Net profit (after tax)</th>
<th>Depreciation</th>
<th>Cash in hand</th>
<th>Repayment of Instalment</th>
<th>Net surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 70%</td>
<td>15978656</td>
<td>10260000</td>
<td>262368608</td>
<td>25989257</td>
<td>249400</td>
</tr>
<tr>
<td>2 80%</td>
<td>26354493</td>
<td>8528000</td>
<td>34982493</td>
<td>25989257</td>
<td>8893236</td>
</tr>
<tr>
<td>3 80%</td>
<td>30784482</td>
<td>7110400</td>
<td>37994882</td>
<td>25989257</td>
<td>11905265</td>
</tr>
<tr>
<td>4 90%</td>
<td>40790390</td>
<td>5947520</td>
<td>46737910</td>
<td>25989257</td>
<td>20748653</td>
</tr>
<tr>
<td>5 100%</td>
<td>50661972</td>
<td>4991296</td>
<td>65632268</td>
<td>25989257</td>
<td>29664011</td>
</tr>
</tbody>
</table>
PVC AND CPVC PIPE AND FITTINGS MFG. PLANT [EIRI/EDPR/3527] J.C.1613

PROJECTED BALANCE SHEET FOR (5 YEARS)

<table>
<thead>
<tr>
<th>LIABILITIES</th>
<th>ASSETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promoters Capital</td>
<td>6,99,71,076</td>
</tr>
<tr>
<td>2. Term loans</td>
<td>4,58,25,000</td>
</tr>
<tr>
<td>3. W/C loan</td>
<td>8,41,21,284</td>
</tr>
<tr>
<td></td>
<td>19,99,17,360</td>
</tr>
</tbody>
</table>

1 Year 70 % Capacity

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promoters capital</td>
<td>6,99,71,076</td>
</tr>
<tr>
<td>2. Net Surplus</td>
<td>2,49,400</td>
</tr>
<tr>
<td>3. Term loans</td>
<td>3,66,60,000</td>
</tr>
<tr>
<td>4. W/C loans</td>
<td>6,72,97,028</td>
</tr>
<tr>
<td></td>
<td>17,41,77,504</td>
</tr>
</tbody>
</table>

2 Year 80 % Capacity

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promoters capital</td>
<td>7,02,20,476</td>
</tr>
<tr>
<td>2. Net Surplus</td>
<td>88,93,237</td>
</tr>
<tr>
<td>3. Term loans</td>
<td>2,74,95,000</td>
</tr>
<tr>
<td>4. W/C loans</td>
<td>5,04,72,772</td>
</tr>
<tr>
<td></td>
<td>15,70,81,485</td>
</tr>
</tbody>
</table>

3 Year 80 % Capacity

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promoters capital</td>
<td>7,91,13,713</td>
</tr>
<tr>
<td>2. Net Surplus</td>
<td>1,19,05,626</td>
</tr>
<tr>
<td>3. Term loans</td>
<td>1,83,30,000</td>
</tr>
<tr>
<td>4. W/C loans</td>
<td>3,36,48,516</td>
</tr>
<tr>
<td></td>
<td>14,29,97,855</td>
</tr>
</tbody>
</table>
PVC AND CPVC PIPE AND FITTINGS MFG. PLANT [EIRI/EDPR/3527] J.C.1613

4 Year 90% Capacity

1. Promoters capital 9,10,19,339 1. Depreciated value
2. Net Surplus 2,07,48,654 of Fixed Assets 3,54,54,080
3. Term loans 91,65,000 2. Working Capital 11,64,75,624
4. W/C loans 1,68,24,260 3. Surplus funds 1,41,72,451

13,77,57,253

5 Year 100% Capacity

1. Promoters capital 11,17,67,993 1. Depreciated value
2. Net Surplus 2,96,64,016 of Fixed Assets 3,04,62,784
3. Term loans 0 2. Working Capital 12,94,17,360
4. W/C loans 0 3. Surplus funds 1,84,48,135

14,14,32,009