How to get the most benefit from plastic pipe

Buried pipelines are rapidly replacing many open-channel farm irrigation ditches. Both lined and unlined ditches may likely become obsolete in many areas in the future.

Buried pipelines have many advantages. They eliminate seepage, provide better weed control, take less land out of production, enabling squaring fields by eliminating open ditches and provide better water control with less labor. Also, pipelines have a greater potential for automation. Automatic surface irrigation is just around the corner and installing buried pipelines is a first step in that direction.

Plastic Irrigation Pipe. One factor responsible for the trend toward buried pipelines is the availability of plastic pipe. Three kinds of plastic pipe are used in irrigation: polyvinyl chloride (PVC), polyethylene (PE), and acrylonitrile-butadiene-styrene (ABS). Of the three, PVC is by far the most widely used, followed by PE. Because of its higher design stress, PVC is more economical in larger sizes, whereas PE, because of its much lower design stress, is used mainly for small diameter pipe where flexibility is desired, such as in drip, turf, and small sprinkler lateral systems.

Plastic pipe, and particularly PVC, has a number of desirable qualities for irrigation pipe. It is lightweight and thus can be handled in long lengths, it has a low friction loss because of its smooth surface, is easily joined and installed, is corrosion resistant, and is relatively low in cost. In addition, PVC is not attacked by rodents. PVC for irrigation was pioneered in the U. S. in the 1950s and gained widespread acceptance and use during the 1960s.

Different methods are used for sizing plastic pipe. PVC and ABS are controlled by the outside diameter (OD), while PE is inside diameter- (ID) controlled. The 'controlled' diameter remains the same for a given size or classification of pipe, while the uncontrolled diameter varies as the wall thickness varies for different pressure ratings.

Most PVC pipe used for irrigation is made in two general size classifications: "iron pipe size" (IPS), and "plastic irrigation pipe" (PIP).

IPS pipe sizes have the same outside diameter as iron or steel of the same nominal size. PIP sizes are entirely different than IPS and were developed primarily for irrigation use with size designations established jointly by plastic pipe manufacturers and the Soil Conservation Service. PIP of the same nominal diameter is smaller in size than IPS pipe and therefore has a smaller flow capacity which varies from about 18% less for 4-inch pipe to about 8% less for 12-inch pipe.

PIP is further divided into high-head or "pressure rated" pipe and "low-head" or 50-foot head pipe used in surface or gravity flow systems. PIP pressure rated pipe is used mainly in the central and midwest regions of the U. S. irrigation, while in the eastern and western regions, IPS is predominantly used.

Both IPS and PIP PVC pipe are pressure rated using the "standard dimension ratio" (SDR). This ratio is obtained by dividing the average outside diameter of the pipe by the minimum wall thickness (for PE pipe, the average inside diameter is used).

Thus, pipes of all sizes made from the same material and having the same SDR value all have the same pressure rating. Although used to a lesser extent for irrigation, Schedule 40, 80, and 120 PVC pipe is also available with dimensions corresponding to those of the Schedule series steel pipe. This pipe does not have a constant SDR, and the pressure rating decreases with an increase in diameter because the wall thickness does not increase at a rate to maintain a constant pressure rating. ASAE Standard. In addition to the various size classifications, thermoplastic pipe is manufactured from different materials of various grades, types, and formulations involving many different specifications. There is a need to establish a uniform standard for materials used in the manufacture of plastic irrigation pipe and to promote uniformity in classifying, pressure rating, testing, and marking.

Because of this need, the Water Supply and Conveyance Committee (SW-243) of the American Society of Agricultural Engineers (ASAE) developed a standard specifically for irrigation pipe. This standard entitled "Design, Installation and Performance of Underground, Thermoplastic Irrigation Pipelines" was recently published by the Society as ASAE Standard: ASAE S376. Copies may be obtained from Society headquarters in St. Joseph, Michigan 49085.

(Continued on page 50)

<table>
<thead>
<tr>
<th>SDR</th>
<th>Pressure class rating without surge (psi)</th>
<th>Maximum operating pressure with surge (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5</td>
<td>315</td>
<td>227</td>
</tr>
<tr>
<td>17.0</td>
<td>250</td>
<td>180</td>
</tr>
<tr>
<td>21.0</td>
<td>200</td>
<td>144</td>
</tr>
<tr>
<td>26.0</td>
<td>160</td>
<td>115</td>
</tr>
<tr>
<td>32.5</td>
<td>125</td>
<td>90</td>
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<tr>
<td>41.0</td>
<td>100</td>
<td>72</td>
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<tr>
<td>51.0</td>
<td>80</td>
<td>58</td>
</tr>
<tr>
<td>81.0</td>
<td>50</td>
<td>36</td>
</tr>
<tr>
<td>Low-head</td>
<td>-</td>
<td>22 (50' head)</td>
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</tbody>
</table>
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Waterhammer. An important consideration in the design of a pipeline is that of waterhammer. The ASAE standard specifies that the normal operating pressure plus surge pressures shall not exceed the pressure class rating of the pipe. If the actual surge pressures are not known, then it is recommended that the maximum operating pressure not exceed 75% of the pressure class rating. To limit the amount of surge pressure that can develop, the water velocity at system capacity should not exceed 5 feet per second.

Maximum operating pressures for PVC pipe without and with surge for various SDR values are shown in Table 1. Values shown are for PVC 1120, which is the material from which over 90% of the PVC irrigation pipe is made.

Excessive waterhammer pressures can occur by closing the pipeline valves too rapidly. To limit the pressure buildup to that which will not damage the pipe, the minimum valve closing times should not be less than those shown in Table 2 for various classes of pipe.

If valve closing times are not less than those shown, the surge pressure due to valve closing, for most operating conditions, will not be greater than about 1/5 of the pressure class rating of the pipe. Thus, for pipe operating at pressures shown in Table 1, the operating plus surge pressures together will not exceed the pressure class rating of the pipe. The longer the pipe, proportionally longer times should be taken to close the discharge valve.

Entrapped air can both restrict the flow at high points in the line, and also cause waterhammer problems, especially when released suddenly from the pipeline. Air release and vacuum relief valves, as indicated in the standard, should be installed at all high points, at the ends, and at the entrance of pipelines to provide for air release and air entrance.

Install pressure relief valves between the pump discharge and the pipeline if excessive pressures can develop by operating with all valves closed, and on the discharge side of the check valve and at the end of the pipeline if surge pressures can develop. The ASAE standard contains minimum guidelines for sizing air/vacuum release valves for both high and low pressure systems. Minimum design criteria and vent requirements for low-head pipeline systems, particularly those operating in the atmosphere, including systems with different types of stands, are also shown.

**Installation.** A number of pipeline failures have occurred, particularly with thin-walled, low-pressure/low-head pipe. These failures occurred primarily because of improper installation and/or operating procedures. It is important that you follow minimum installation requirements concerning trench construction, pipe handling and placement, bedding, and backfill procedures.

Low-head and low-pressure (SDR 81) pipe have adequate strength to withstand internal design pressures, but because of their thin walls are very susceptible to damage and collapse from external loading. Always use the water-packing method when installing this pipe. The initial backfill material immediately surrounding the pipe should be fine-grained and free from sharp or pointed rocks or stones and aggregate no larger than 1/2-inch diameter. The backfill is consolidated by adding water to completely saturate it.

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### Table 2

<table>
<thead>
<tr>
<th>SDR</th>
<th>Pipe Class (Pressure rating)</th>
<th>Valve closing time in seconds</th>
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<tbody>
<tr>
<td></td>
<td>(psi)</td>
<td>Pipe Length</td>
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<tr>
<td>-----</td>
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<td>-------------</td>
</tr>
<tr>
<td>13.5</td>
<td>315</td>
<td>1,000 ft.</td>
</tr>
<tr>
<td>17.0</td>
<td>250</td>
<td>1,000 ft.</td>
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<td>1,000 ft.</td>
</tr>
<tr>
<td>41.0</td>
<td>100</td>
<td>1,000 ft.</td>
</tr>
<tr>
<td>51.0</td>
<td>80</td>
<td>1,000 ft.</td>
</tr>
<tr>
<td>81.0</td>
<td>50</td>
<td>1,000 ft.</td>
</tr>
</tbody>
</table>

Low-head 50-ft. head | 21.9 | 43.8 (3.8 min.)

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(Continued from page 28)
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It's a Fairbanks Morse Turbine Pump.

"Quite a few farmers around here have Fairbanks Morse pumps, and they never seem to have any problems."
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- Deep—Shallow Well Turbine Pumps
- Grind-O-Mix
- Forage Harvester
- Seed Bed Makers
- Seed Roller Mills

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<tr>
<td>CITY</td>
<td>STATE</td>
</tr>
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</table>

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(Continued from page 35)
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2. **Extravagantly mounted HEAVY DUTY ACTUATION SWITCHES** are used to stop and start the tower and to maintain machine alignment. Because they are weatherproof and totally sealed against moisture, they are not subject to nuisance failures. The switches used on the pivot are designed for high success rates.

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