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DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

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TO: Water Well Drilling Contractors
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Local Health Departments:
Attn: Environmental Health Directors
Water Supply Sanitarians

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Drinking Water and Environmental Health Section
Lansing Operations Division
Water Bureau

DATE: August 24, 2005

SUBJECT: **Advisory on PCBs in Older Submersible Water Well Pumps**

A recent incident in Eaton County is a reminder of the potential for drinking water contamination and health risks from PCBs (polychlorinated biphenyls) leaking from older submersible water well pumps. ***Well drillers, pump installers, and local health departments should notify the Department of Environmental Quality (DEQ), Water Bureau, Contamination Investigation Unit, at 517-241-1374 when a submersible pump known to have PCBs is encountered.***

The precautions and practices described in the attached handouts should be used when oil-filled motors or two-wire submersible pumps manufactured before 1980 are serviced. The DEQ, Water Bureau, recently posted the attached information on its Internet website to inform consumers about the associated public health threat.

Several two-wire submersible pumps manufactured before 1980 contain electrical capacitors with PCBs. Additionally, some submersible pump motors from that era were filled with nonfood grade lubricating oil that may have contained PCBs. The water well industry and health officials first became aware of this problem in 1986 after nationwide publicity of PCB contamination incidents. Pumps installed before 1980 that are still in service are approaching the end of their service life (average 12 years). While most PCB-laden pumps are likely to have been replaced, contractors will continue to encounter them. Because of the lack of reporting when well pumps are replaced, state officials cannot identify the locations of PCB-laden pumps that remain in service.

Last month a private household well near Sunfield was contaminated with high levels of PCBs after a service call by a local well driller. While trying to remove the failing submersible pump, the drop pipe broke and the pump fell to the bottom of the 285 foot (ft.) bedrock well. The pump was left downhole, a replacement pump was installed, and family members resumed using the well. A few days later the homeowners noticed a strong petroleum odor in the water and called the well driller. When the new pump was pulled it was coated with oil. Upon retrieval of the original pump, the capacitor housing was intact and it was uncertain as to how the oil leak occurred.

The homeowner and driller called the DEQ PEAS (Pollution Emergency Alerting System) Hotline to report the incident. When it was suspected that the pump might contain PCBs, the owner contacted the pump manufacturer. A company representative confirmed the presence of PCBs in the specific pump model. A DEQ official collected water and oil samples. About one inch of oil was floating on the water. Laboratory analysis detected Aroclor 1016, a PCB compound, at 110 parts per billion in the water (220 times the EPA Maximum Contaminant Level of 0.5 ppb). The PCB concentration in the oil in the pump was 2,900 parts per million.

An environmental remediation contractor hired by the pump manufacturer conducted an extensive cleanup. The well pump, pressure tank, hot water heater, and water softener were replaced. Postcleanup monitoring did not detect PCBs. This unfortunate incident resulted in the homeowners and their family being exposed to PCBs and being without the use of their well for over a month.

The attached materials cover the nature of the PCB problem, health risks, and steps to take when PCB-laden pumps are encountered.

Attachments

cc: Michigan Ground Water Association
Groundwater Advisory Committee
Jim Sygo, Deputy Director, DEQ
Richard A. Powers, DEQ
James K. Cleland, DEQ
Andrew Hogarth, DEQ
Joe Lovato, DEQ
Amy Merricle, DEQ
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PCB Contamination Potential from Older Submersible Well Pumps

What are PCBs?

Polychlorinated biphenyls (PCBs) are synthetic (man-made) chlorinated hydrocarbons similar to pesticides. There are no known natural sources of PCBs. They are generally colorless to light yellow, odorless, tasteless, have a thick consistency, high density, are insoluble in water, and immobile in soils. Some PCBs are volatile and may exist as vapors in air. Because of their low electric conductance and insulating properties they were used extensively as dielectric fluids in electrical capacitors and transformers. PCBs were also used in hydraulic fluids, plasticizers, fire retardants, and as a component of carbonless copy paper. The manufacture of PCBs was banned by the EPA in 1976 and most uses of PCBs were banned in 1979.

How do PCBs contaminate the well water?

The failure of seals within certain submersible pump motors due to normal wear, lightning strike, electrical power surges, or other damage can release PCB-tainted oil into the household drinking water system. Capacitors within the motors of certain two-wire submersible pump models manufactured before 1980 contain PCBs, which can leak into the surrounding lubricating oil. Oil can leak from an oil-cooled submersible pump motor slowly without notice by the homeowner. The leak may not be apparent until the pump fails and the well is serviced. Unfortunately, by that time PCB-tainted water may have been consumed. In the case of a lightning strike, oil can be released suddenly from the pump motor and an immediate change in the taste/odor of the drinking water can occur. The low density of the oil causes it to rise to the top of the water column where it coats the interior of the well casing, particularly in the drawdown zone. The oil mixes with the well water and the submersible pump distributes the tainted water into the pressure tank and throughout the household plumbing.

What are the health risks from PCB exposure?

The United States Environmental Protection Agency (USEPA) notes that PCBs have the potential to cause short-term health effects such as acne-like eruptions (chlorachne) and pigmentation of the skin, hearing and vision problems, and spasms. Long-term exposure above the 0.5 parts per billion maximum contaminant level (MCL) can cause irritation of the nose, throat, and gastrointestinal tracts, and changes in liver function. PCBs are known animal carcinogens (cancer-causing) and probable human carcinogens. Few studies associated PCBs with cancers of the liver and biliary tract in workers. PCBs bioaccumulate in the body, primarily in the liver and fatty tissue. PCBs collect in milk fat and can be passed to infants through breast-feeding. There is no evidence of structural birth defects caused by PCBs, but motor skill deficiencies and a decrease in short-term memory have been implicated in children born to mothers who ate PCB-contaminated fish. PCBs do not break down naturally in the environment and can persist for years.

What are the drinking water standards for PCBs?

The USEPA established a Maximum Contaminant Level (MCL) of 0.0005 mg/l (ppm) or 0.5 parts per billion. The maximum contaminant level goal (MCLG) below which there are no known health effects is zero.

Which pumps contain PCBs?

Attached are listings of submersible pump models known to contain PCBs and those with oil-filled motors that may pose a contamination threat. These listings were compiled from the mid-1980s to early 1990's and are the same as the listings previously distributed by the Michigan Department of Public Health. Corporate restructuring in the past decade has made some of the information in the listings obsolete.

If a well has a pump listed as having PCBs or nonfood-grade oil, what should be done?
To reduce exposure risks, well owners with pump models on the attached listing should replace their pumps. If a PCB-laden pump or a pump with nonfood-grade oil is in the well, the water should be analyzed for PCBs and volatile organic chemicals regardless of whether there are signs of pump failure. The homeowner or water well driller should notify the pump manufacturer for assistance.

If a local health department sanitarian or private-sector well inspector discovers a probable PCB-laden pump or pump with nonfood-grade oil during an inspection, the condition should be documented on the inspection report.

If a PCB-laden pump is encountered, the DEQ, Water Bureau, Well Construction Unit should be contacted at 517-241-1389 before removal of the pump.

How can well owners tell if their pumps have PCBs?
The model of the pump may be included on the water well record that was filed by the water well contractor. Well owners can use the following DEQ website to search for their well record. They need the county, township and section to complete the search.

www.deq.state.mi.us/well-logs/

Pump model numbers are in the lower right portion of the well record. The pump model number on the well record should be compared to the attached listing of PCB-laden pumps.

PCBs are not a concern in submersible pumps manufactured after 1979 or in pumps with three-wire, water-cooled motors. A three-wire pump has a separate pump control box usually located near the pressure tank. A two-wire pump has the capacitors within the pump motor and a separate motor control box is not present.

Submersible pumps sold today are water-lubricated and do not contain PCB capacitors. Since 1994, Michigan's water well code has required submersible pump motor lubricants to be of FDA food-contact-grade formulation. There is not a PCB concern with shallow-well jets pumps, deep-well jet pumps, centrifugal pumps, or other pumps located outside the well.

What if oil Is leaking into a well?
If the water has an oily taste/odor or film the homeowner should **immediately refrain from drinking, cooking with, or bathing in the well water** until water testing has been conducted. Bottled water is recommended as a temporary water supply until testing has confirmed the safety of the well water. If the pump is an oil-filled model, the well water should be analyzed for PCBs and volatile organic chemicals. Oil leakage from the pump means that motors seals are worn or have failed and pump replacement is inevitable.

If the pump motor is water-lubricated and an oily taste/odor/film is present, other possible causes should be investigated. A fuel storage tank leaking into the aquifer or a bacterial infestation in the well may be the cause of the oily taste/odor problem. Water testing for volatile organic compounds and/or iron bacteria, sulfate-reducing bacteria, pseudomonads and coliform microorganisms is recommended.

Where can a water analysis for PCBs be obtained?
The Michigan Department of Environmental Quality, Drinking Water Laboratory, analyzes drinking water for PCBs using USEPA Method 525.5, Rev 2.0 - Methods for the Determination of Organic Compounds in Drinking Water – Supplement III (EPA/600/R-95-131). A nonvolatile organic chemistry scan (same scan is used for pesticides) is performed using a number 36NV sampling unit with a test code of CXPT. The fee is $120.00. For questions regarding testing, contact the Drinking Water Laboratory at 517-241-8184 (Lansing) or 906-482-3011 (Houghton).

Some private laboratories may also perform PCB analyses. A listing of private laboratories is available on the DEQ website at:

www.michigan.gov/deq

Click on "Water", followed by "Drinking Water" and under the "Quick Links" heading, select "Drinking Water Analyses Laboratory" to arrive at the "Environmental & Drinking Water Testing Labs Directory".

What safety precautions should a water well drilling contractor take when servicing a well with a pump that is leaking oil or suspected of containing PCBs?

To protect contractors and their employees, protective clothing and eyewear should be worn while handling a pump that is leaking oil unless it has been confirmed that the pump does not contain PCBs and has food-grade oil. Use disposable rubber gloves to handle the pump and drop pipe. If skin contact occurs, immediately wash with strong soap and water.

When a PCB-laden pump is removed from a well the pump should be carefully inspected to be sure that all pump components are intact. If the capacitor or capacitor housing are left in the well, residual PCB contamination could occur.

Oil should not be allowed to spill onto soil or pavement. If a spill occurs, it should be cleaned up immediately with oil-soaking absorbents, bentonite clay, or cat litter.

What if a suspected PCB pump is stuck in the well?

A diligent attempt must be made to remove the pump, but caution is warranted. Leaving the pump in the well can result in contamination, but excessive force while fishing for the pump can cause physical damage and oil can be released into the well. Observing the position of the pump by inspection with a downhole TV camera aids in selecting the proper fishing tools. If fishing is unsuccessful, entombing the pump in cement grout or pump/casing extraction by overdrilling may be necessary.

If a PCB-laden pump is stuck downhole, the well driller should contact the DEQ, Well Construction Unit at 517-241-1374 for advice before proceeding.

Where can a PCB-contaminated pump be disposed?

PCB-laden pumps are considered municipal solid waste and can be disposed of in a Type II waste disposal facility. Place the submersible pump in a container such as a length of pipe with leakproof caps. The pump can also be wrapped in multiple layers of plastic sheeting (at least 10 mil. thickness) and tightly taped.

How is a PCB/oil-contaminated water system restored?

Restoration of a PCB/oil-contaminated well can be labor intensive and costly. The basic steps are:

- Skim free oil product off water surface using a bailer or absorbent "socks." Retain oil and oil-soaked absorbent materials in container for proper disposal.
- Use well cleaning chemicals (surfactants or dispersants) formulated for oil removal. Well rehabilitation chemicals shall be listed in compliance with *ANSI/NSF Standard 60 – Drinking Water Treatment Chemicals – Health Effects*).
- Use swabbing tool, brush, or high pressure-washing to scrub casing after cleaning solution is added.
- Recirculate cleaning solution in well for at least 30 minutes – wash down inside of casing.
- Run cleaning solution into plumbing to capture oil residue in pipes.

- Flush cleaning solution through a granular activated charcoal filter and discharge wastewater to an appropriate site at least 100 feet from surface water.
- Collect water samples for PCB and volatile organic chemical (VOC) analysis.
- Do not return the well to service until PCBs and VOCs are not detected (or below MCLs) after successive water testing.
- Retain spent PCB-laden charcoal filter material for disposal along with pump and other contaminated materials at an approved facility or with a licensed waste-hauler.

For further assistance:

Michigan Department of Environmental Quality
Water Bureau
Lansing Operations Division
Drinking Water and Environmental Health Section
Well Construction Unit
P.O. Box 30273
Lansing, MI 48909-7773
Phone: 517-241-1389
Fax: 517-241-1328

References:

The Potential for Drinking Water Contamination from Submersible Well Pumps, Wisconsin Department of Natural Resources, Bureau of Water Supply, PUBL-WS-025-92, 1992.

Technical Factsheet on Polychlorinated Biphenyls (PCBs), U.S. Environmental Protection Agency, Ground Water & Drinking Water, 2005, Internet website.

Toxicological Profile for Polychlorinated Biphenyls (PCBs), Agency for Toxic Substances and Disease Registry, November 2000, Internet website.

Removing PCB-Laden Pumps, Huntoon, Edwin, Ground Water Age, January 1993.

Michigan Department of Public Health, Ground Water Quality Control Section, Memorandum of June 30, 1986.

SUBMERSIBLE PUMP UNITS
KNOWN TO CONTAIN PCBs

The following manufacturer's models and serial numbers have been compiled from literature searches and information supplied by pump installers and pump manufacturers. This information represents the best descriptions currently available.

Please be aware that the list is not complete with regard to all manufacturers and brand names and the information has not been confirmed in all cases. Although the list is the best available, its accuracy cannot be guaranteed.

The available information is for pumps manufactured after 1960. Some brand contained PCBs prior to 1960 but did not contain PCBs after 1960.

The following units are those identified as sources of PCB contamination in well water:

Dempster Industries: Before 1964 Dempster may have distributed pump units manufactured by REDA and Sta-Rite that may have contained PCBs. Use the REDA and Sta-Rite identification data for those pump units.

F.E. Myers: Models SF and SF-2, 2-wire units manufactured from 1964 through 1970 in 1/3 to 1 horsepower (HP)and Models SG and S2G, 2-wire units manufactured from 1970 through 1976 in 1/3 to 1 HP with date codes prior to 1976. Some SX2 models manufactured before 1979 had capacitors containing less than 50 parts per million of PCBs. The date code is located on the motor casing and on a nameplate or tag in the format MMYY (Example: "1177" = November 1977).

Fairbanks Morse: Two-wire units manufactured from 1964 through January 1979 gave a coded alpha-numeric date code found on the nameplate. Included are the Colonial series and the Chateau series units with date codes of A___, B__, C____, J_____, K___, L____, M___, N____, P____, R____, S____, T____, V_____, W___, X___, and DA_____. The blanks are filled in with additional characters.

Series	Model Numbers				
Colonial	A2-2507	C2-3306	E2-7509	G2-1009	
	A2-3309	C2-7511	E2-10011		
	A2-5012				
Chateau	A2S-3309	C2S-3306	E2S-7509	G2S-1009	273
	A2S-5012	C2S-5008	E2S-10011	G2S-15012	275
	A2S-7517	C2S-7511	E2S-15015		277
	A2S-10021	C2S-10014			

Johnston Water Systems: These pumps were manufactured by Peabody Barnes and are identified as noted under Peabody Barnes listing. Models include:

V507-31	V513-52	V909-51	VSP913-75	V317-150
V507-32	V523-100	V909-52	VSP909-52	V1306-51
V509-31	V531-100	V913-75	VSP909-51	V1307-52
V509-32	V906-31	V917-100	VSP1309-75	V1809-100
V513-51	V906-32	V923-150	VSP313-100	V1813-150

Montgomery Ward: These pumps were manufactured by Peabody Barnes from 1962 to 1972 and are identified as noted under Peabody Barnes listing. Models include:

3677A	3679A	3681C	3682E	3684D	24623
3677B	3679B	3681D	3683C	3675A	24625
3678A	3680C	3682C	3683D	3675B	
3678B	3680D	3682D	3684C	3675C	

Peabody Barnes: Two-wire units are identified with the letter ”W” as part of the model number (Example: “409W52”). In 1977, the letter “N” was added to the model number (Example: “409W52” became “409WN52”). The date codes are the last 3 or 4 digits of the coding, showing month, then year of manufacture (Example: “409WN52-67753-1279” is a 2-wire unit made in December 1979). Codes are found on a stainless steel band around the discharge neck of the pump.

REDA: Two-wire units have a date code on the nameplate with the format MMYY (Example: “0877” is August 1977) All models listed below with a year code of 1979 or earlier are included. All motors had the serial number stamped on the head of the motor preceded by the 4-digit date code.

41100	41101	41120	42070	42090	42091
42121	42131	42171	42181	42251	43091
43121	43131	43171	43181	44091	43251
4D35P101	6D35P151	7D9P030	7D9P031	7D18P071	
9D5P031	9D6P030	9D9P050	9D9P051	10D18P101	
12D5P050	12D5P051	12D9P071	14D18P151	17D5P071	
17D9P101	23D5P101	23D9P151	312X7P050	314X4P050	
320X4P050	32D5P151				

Red Jacket: The capacitor is encapsulated in a plastic housing and the unit is fastened to the bottom of the motor. Although these units may be less likely to leak PCBs, there are confirmed well contamination cases from Red Jacket pump motors. Motor models include designations “BV,” “BVC,” “W,” and “RW,” 1/3 through 1-1/2 HP. The model designation appears as the first part of the identification number (Example: BV 300-2 or 50W0-9BC).

The date of manufacture is found on the motor housing and on the pump and include the following codes:

1968 MC____and NC_____	1969 AD____through ND___
1970 AE_____ through NE__	1971 AF____through NF___
1972 AG_____ through NG__	1973 AH____through NH___
1974 AK_____ through NK__	1975 AL____through NL___
1976 AM_____ through NM__	1977 AN____through NN___

_____ _____ _____ 78 (Examples: “20378” is 2nd week of March 1978)

“3FHR” is 3rd week of June 1973.

Sta-Rite: Two-wire units have a date code on the nameplate with the format MYY. The month is coded as a letter from “A” to “M” and the year is a number. (Example: “B77” is February 1977). Units dated 1979 or earlier are included.

(Note: Some 3-wire motors with Sta-Rite labels have been verified containing PCB.)

(Source: Wisconsin Department of Natural Resources)

IDENTIFYING OIL- FILLED MOTORS

The following list of oil filled submersible pump motors was compiled from information the Wisconsin Department of Natural Resources obtained from the manufacturers, well drillers, pump installers, technical journals, sales literature, field examination, and limited analytical analysis. The list is not exhaustive. Because of the variability of petroleum products and the motor manufacturing process, it is impossible to provide greater accuracy at this time.

It is important to note that in most cases, specific model identification or serial numbers were not provided making identification of specific motor units difficult.

A.O.SMITH – Representatives of this company state that their records indicate that oils recognized as food-grade by the FDA were used in submersible pump motors. However, they did not provide any supporting documentation or copies of their records.

BARNES – Also known as Peabody Barnes, Inc., this company was acquired by Burks Pumps, Inc. Representatives of Burks Pumps state that the oils used in Barnes submersible motors was a paraffinic type oil. No documentation was provided to indicate whether the oil used in these submersible pump motors was food-grade. Limited analytical data suggests that oils used in Peabody Barnes submersible motors were unlikely food-grade. Montgomery Ward and Johnston Water Systems used motors supplied by Barnes at various times.

BYRON JACKSON – Currently known as BW/IP International, Inc., documentation was provided indicating that submersible pump motors currently produced by this company contain food-grade oil. Documentation indicating whether oils were food-grade was not provided for motors produced before 1990.

CENTURY – Century Electric Motors was previously a division of Transamerica/Delavall, now known as IMO. Century motors were used on many submersible pump brands including but not limited to Aeromotor, Berkeley, Tait, Pumptron, Red Jacket, Rapidayton, Webtrol, Flint & Walling, and Teel/Granger. Century Motors ceased operation in 1986 though many of the brands that used Century motors are still available. Manufacturers who purchased name brands associated with Century Motors have provided documentation indicating that food-grade oil was used from 1978 to 1986 and state that oil used between 1962 and 1978 was food-grade though they did not provide sufficient supporting documentation. Limited analytical data suggests that at least some of the oil used in at least some pre-1978 motors was probably non-food-grade.

EXODYNE – Exodyne purchased the assets of Magney Electric Motors, Inc. Documentation was provided indicating that submersible pump motors currently produced by Exodyne contain food-grade oil. Documentation for motors produced by Magney Electric Motors before 1991 was not available.

F.E. MYERS – Documentation provided by F.E. Myers and analytical data confirm that nonfood-grade oil has been used in oil-filled submersible pump motors manufactured by Myers. Between 1981 and 1983, Myers discontinued oil-filled motors and converted to water – filled motor technology. All Myers submersible motors since 1983 use a water-filled design.

FAIRBANKS MORSE – Except for pumps utilizing Franklin water-cooled motors, all motors contain oil. Fairbanks Morse has provided documentation indicating that food-grade oil was used in motors manufactured from 1978 to 1990. Company representatives state that “Information available to Fairbanks Morse is that from 1969 to 1978 an oil which was used

was FDA approved and non-toxic." Documentation provided by Fairbanks Morse does not indicate that the oil used from 1969 to 1978 was FDA-approved, food-grade material.

GENERAL ELECTRIC – General Electric (GE) indicated that they were not going to review their records to determine what types of oil were used in the various submersible pump motors they manufactured. PCBs have been found in GE submersible pump motor oil, the presence of which require a nonfood-grade classification. GE motors were used on various brands of submersible pumps, e.g. Hoosier.

RED JACKET – Currently, Red Jacket is a division of the Marley Pump Company. Submersible pump motors manufactured by Red Jacket are water cooled and do not contain oil. However, Century Electric submersible pump motors were used on 3,000 of the Red Jacket pumps nationwide between 1978 and 1981. Documentation has been provided indicating that food-grade oil was used in these motors. See the Century Motor section relative to these motors.

REDA, A CAMCO COMPANY – REDA was previously a division of TRW. Representatives of REDA state that REDA has not manufactured a submersible pump for use in potable water supply wells since 1979. Documentation has been provided indicating that food-grade oil was used in motors designed for use in potable water supply wells from 1965 through 1979. REDA has also manufactured motors for purposes other than potable water supply wells that do not contain food-grade oil. They state that they do not know whether some of these motors may have been installed in potable water supply wells. Prior to 1965, REDA motors contained nonfood-grade oil. REDA motors were supplied to various manufacturers during the 1950s including Clayton-Mark, Dempster, Duro, Flint and Walling, Rapidayton, Red Jacket, Rom, and Woodmansey.

STA-RITE – Documentation was provided indicating that food-grade oils were used in submersible pump motors manufactured between 1961 and 1966 and from 1975 through 1991. Representatives of STA-RITE state that food-grade oils were always used in submersible motors but did not provide sufficient conformational documentation for motors manufactured prior to 1961 and between 1966 and 1975. However, limited analytical data suggests that food-grade oil was used. STA-RITE also supplied motors to Sears, Roebuck and Company.

(Source: Wisconsin Department of Natural Resources)