If you look at the pictures, it's not too much of a mystery what happened to this 2001 Tohatsu 4-stroke engine. But take a guess anyway! To learn more about where the elements are coming from, click here.

	MI/HR on Oil	া ়	to prove the		
	MI/HR on Unit		UNIT /		UNIVE RSA L
	Sample Date	1/2/2018	AVERAGES		A VERA GES
	Make Up Oil Added				
) N	ALUMINUM	9	10		6
Ξ	CHROMIUM	0	0	1	1
	IRON	57	64	No. 2 No. 2	24
	COPPER	3	3		7
Ľ	LEAD	0	1	Totol Cont	2
α.	TIN	0	0		0
S	MOLYBDENUM	133	115	Contraction of the last	95
Ŧ	NICKEL	0	0	500	0
	MANGANESE	0	0		0
	SILVER	0	0		0
	TITANIUM	0	0		0
-	POTASSIUM	1	1		1
í	BORON	78	84		48
-	SILICON	4	6		11
	SODIUM	20	17		11
	CALCIUM	1519	1335	A AN MARKED AND	1692
	MAGNESIUM	33	248		68
	PHOSPHORUS	585	624		703
	ZINC	681	716		845
	BARIUM	0	0		0
	2		Values		
			Should Be*		
	SUS Viscosity @ 210°F	70.4	65-76		
	cSt Viscosity @ 100°C	13.05	11.6-14.8	and the second sec	2
2	Flashpoint in °F	400	>375		
	Fuel %	< 0.5	<3.0		5
Ŷ	Antifreeze %	?	0.0	的复数化学 化合理学 法法律法律	
	Water %	0.0	<0.1		
9	Insolubles %	0.2	<0.6		2
-	TBN			тор: barnacies galore.	
	TAN			Bottom: Old zinc plate vs new.	
	ISO Code		10		1.25

This engine sat flooded, convered in barnacles, underwater on the bottom of a southern Califonia boat launch for about a year. Here's the story: "I originally found the sunk motor on Craigslist for sale by the marine biologist who recovered it. Judging by the size of some of the barnacles on the motor, I'm guessing it was underwater for up to a year - possibly longer. The clamps were stuck in a wide-open position so I think someone forgot to tighten them before they launched and the motor fell off the boat and sunk.

My plan was to use this as a parts motor for my Tohatsu 5 hp LS. When I bought the engine, it was covered in barnacles with sea water and grit sloshing around in the gear case. It was advertised as not seized, but it very much was. The prop spun in neutral, but that's about it. The condition of the outside of the motor was quite good. The zinc at the bottom of the drive leg was nearly completely dissolved and looked like Swiss cheese. But it had done a good job of protecting the motor. (Story continues on next report.)

If you look at the pictures, it's not too much of a mystery what happened to this 2001 Tohatsu 4-stroke engine. But take a guess anyway! To learn more about where the elements are coming from, click here.

Milke on Unit Unit of the service		MI/HR on Oil	1	11507.7					0		
Sample Date 1/2/2018 AVERAGES Make Up Oil Added AVERAGES Make Up Oil Added AVERAGES ALUMINUM 18 10 IRON 133 64 COPPER 4 31 LEAD 1 1 NICKEL 1 0 POTASSIUM 1 1 SODIUM 11 1 Solud Be* 8 glad your cylinders don't look like this. 66 Stander 9 61 13 Stander 9 1 1 16 Stoc		MI/HR on Unit		LOCATION -						UNIVERSAL	
Make Up Oil Added Image: Construction of the second of		Sample Date	1/2/2018	AVERAGES]]	AVERA GES	
MUNINUM 18 10 CHRCMIUM 1 0 IRON 133 64 IROPER 4 3 LEAD 1 1 IN 0 0 MOLYBDENUM 82 115 NICKEL 1 0 SILVER 0 0 CALCIUM 998 1335 MARKESUM 679 244 SILCON 9 6 SOLUM 11 177 CALCUM 998 1335 MARNESUM 679 244 ZNC 793 716 BARNM 0 0 1 Values Should Be ⁴ 1 Stososty @ 210°F 63.6 69.65		Make Up Oil Added	1								
OT CHROMIUM 18 10 LUMINUM 1 0 IRON 133 64 COPPER 4 3 LEAD 1 1 TIN 0 0 MOLYBDENUM 82 115 MICKEL 1 0 MANGANESE 1 0 SILVER 0 0 TTANIUM 0 0 POTASSIM 1 1 BORON 92 84 SULCON 9 6 SODIUM 11 17 CALCIUM 988 1336 MARORESUM 679 248 PHOSPHORUS 727 624 PHOSPHORUS 727 624 SUS Viscosity @ 210°F 63.6 59-65 CSI Viscosity @ 210°F 63.6 59-65 SUS Viscosity @ 100°C 11.2 9.9-11.9 Flashpoint in °F 405 5375 Fuel % 0.0 0 1 Yeales 0.0 0 1 <td></td> <td></td> <td></td> <td></td> <td>Sin A</td> <td></td> <td>1111</td> <td>14</td> <td></td> <td></td>					Sin A		1111	14			
CHROMIUM 1 0 133 64 COPPER 4 3 64 22 LEAD 1 1 1 24 MOLYBDENUM 82 115 1 1 99 NICKEL 1 0 0 99 99 SLVER 0 0 0 99 99 SLVER 0 0 0 0 0 0 BORON 92 84 98 11	NO	ALUMINUM	18	10		121	Alle Maria			6	
IRON 133 64 COPPER 4 3 LEAD 1 1 TIN 0 0 MCKEL 1 0 NICKEL 1 0 TITANIUM 0 0 POTASSIUM 1 1 BORON 92 84 SLICER 0 0 POTASSIUM 1 1 BORON 92 84 SLICON 9 6 SODUM 11 177 CALCIUM 998 1335 MAGNESUM 679 248 PHOSPHORUS 727 624 ZINC 793 716 BARIUM 0 0 0 Values Should Bet SUS Misosity (@ 210°F SUS Misosity (@ 210°F Gald 59-65 Fuel % -0.5 Fuel % 0.0 -0 Mattheeze % 0.0 -0 Mattheeze % 0.0 -0		CHROMIUM	1	0	1111	1	100 A 17		the last	1	
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LEAD 1 1 TIN 0 0 MOLYBDENUM 82 115 NICKEL 1 0 NICKEL 1 0 SLVER 0 0 TITANUM 0 0 POTASSIUM 1 1 SULCON 9 6 SODUM 11 17 CALCIUM 998 1336 PHOSPHORUS 727 624 ZNC 793 716 BARIUM 0 0 0 BARIUM 0 0 0 Values Should Be* 375 SUS Viscosity @ 210°F 63.6 59-65 GSU Viscosity @ 210°F 63.6 59-65 Flashpoint in °F 405 375 Fuel % <0.5		COPPER	- 4	3			6	2	1.00	7	
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MOLYBDENUM 82 115 MCKEL 1 0 MANGANESE 1 0 SLVER 0 0 TITANIUM 0 0 POTASSIUM 1 1 SULVER 0 0 SULVER 0 0 POTASSIUM 1 1 SULCON 9 6 SULCON 9 6 SULCON 9 6 SODUM 11 17 CALCUM 998 1335 MAGNESIUM 679 248 PHOSPHORUS 727 624 ZINC 793 716 BarluM 0 0 0 Values Should Be* Should Be* Stoud Sty @ 100°C Sus Macosity @ 210°F 63.6 59-65 CS Macosity @ 210°F 63.6 59-65 1 Fuel % <0.0	Ъ	TIN	0	0				0			
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MANGANESE 1 0 SILVER 0 0 SILVER 0 0 POTASSIUM 1 1 BORON 92 84 SILICON 9 6 SODIUM 11 17 CALCIUM 998 1335 MASNESIUM 679 248 PHOSPHORUS 727 624 ZINC 793 716 BARIUM 0 0 0 0 Values Should Be* 375 1 SUS Mscostly @ 210°F 63.6 59-65 1 1 CST Mscostly @ 210°F 63.6 59-65 1 1 Values 375 1 1 1 Fuel % 0.0 0.0 1 1 Values 1 1 1 1 Insolubles % 0.2< 0.6 1 1 Insolubles % 0.2 0.6 <th1< th=""> <th1< th=""></th1<></th1<>	K.	NICKEL	1	0			Labor and	- are - 3/		0	
SILVER 0 0 0 TITANIUM 0 0 0 0 POTASSIUM 1 1 1 1 BORON 92 84 445 SILICON 9 6 11 SODUM 11 17 446 CALCIUM 998 1336 1692 MAGNESIUM 679 248 1692 PHOSPHORUS 727 624 1692 JNC 793 716 8445 BARIUM 0 0 0 0 Values Should Be* Should Be* Should Be* Values Should Be* Should Be* Should Be* Unitime rs Unitime rs Unitime rs Should Be* Unitime rs Unitime rs <td c<="" td=""><td>P</td><td>MANGANESE</td><td>ୀ</td><td>0</td><td>NOR I</td><td></td><td>A A A A A A A A A A A A A A A A A A A</td><td>1 1</td><td></td><td>0</td></td>	<td>P</td> <td>MANGANESE</td> <td>ୀ</td> <td>0</td> <td>NOR I</td> <td></td> <td>A A A A A A A A A A A A A A A A A A A</td> <td>1 1</td> <td></td> <td>0</td>	P	MANGANESE	ୀ	0	NOR I		A A A A A A A A A A A A A A A A A A A	1 1		0
TITANIUM 0 0 0 POTASSIUM 1 1 1 BORON 92 84 48 SILICON 9 6 11 SODIUM 11 17 11 CALCIUM 998 1335 469 MAGNESIUM 679 248 1692 PHOSPHORUS 727 624 703 ZINC 793 716 84 BARIUM 0 0 1 68 Values Should Be* Should Be* Should Be* Stould Be* Values Should Be* Stould Be* Stould Be* Stould Be* Values Should Be* Stould Be*	z	SILVER	0	©0		A STATE	Care 3. E			0	
POTASSIUM 1	10	TITANIUM	0	0	125	1 10 10			States -	0	
BORON 92 84 48 SILICON 9 6 11 SODIUM 11 17 11 CALCIUM 998 1335 6 MAGNESIUM 679 248 9 PHOSPHORUS 727 624 66 ZINC 793 716 8 BARIUM 0 0 0 0 Values Should Be*	Ě	POTASSIUM	1	1		A MARINA	Sec. Sugara	14		1	
SILICON 9 6 11 SODIUM 11 17 11 11 CALCIUM 998 1335 1682 1682 PHOSPHORUS 727 624 703 682 PHOSPHORUS 727 624 703 845 BARIUM 0 0 0 845 Startum 0 0 0 0 0 Values Should Be* SUS Viscosity @ 210°F 63.6 59-65 0 0 0 0 0 Values Should Be* Should Be* SUS Viscosity @ 210°F 63.6 59-65 0 0 0 0 CSU Viscosity @ 100°C 11.22 9.9-11.9 0 0 0 0 0 Fuel % <0.5	É	BORON	92	84		1 Mary		12 11	N SO	48	
SODIUM 11 17 11 17 CALCIUM 998 1335 Be glad your cylinders don't look like this. 668 PHOSPHORUS 727 624 68 703 ZNC 793 716 Be glad your cylinders don't look like this. 68 BARIUM 0 0 0 0 68 Values Should Be* 845 703 703 Values Should Be* Sus viscosity @ 210°F 63.6 59-65 0 0 0 CSUS Viscosity @ 210°F 63.6 59-65 0 0 0 0 Should Be* SUS Viscosity @ 100°C 11.22 9.9-11.9 0 0 0 0 0 Fuel % <0.5		SILICON	9	6			the second secon	1 Al	Start.	11	
CALCIUM 998 1335 1692 MAGNESIUM 679 248 Be glad your cylinders don't look like this. 668 PHOSPHORUS 727 624 703 703 ZINC 793 716 846 846 BARIUM 0 0 0 0 0 Values Should Be* SUS Viscosity @ 210°F 63.6 59-65 0		SODIUM	11	17	200	1 Store	Contractor of	AP	119	11	
MAGNESIUM 679 248 Be glad your cylinders don't look like this. 66 PHOSPHORUS 727 624 703 704 845 703 703 704 703 704 703 704 703 704 703 704 703 704 703 704 703 704 703 704 703 704 703 704 703 704 704 703 704 <t< td=""><td></td><td>CALCIUM</td><td>998</td><td>1335</td><td></td><td></td><td>Contract of the second s</td><td></td><td></td><td>1692</td></t<>		CALCIUM	998	1335			Contract of the second s			1692	
PHOSPHORUS 727 624 To grad year of matrix of an of matrix and the matrix andit and the matrix and the matrix and the matrix and the matrix and		MAGNESIUM	679	248	Be glad	68					
ZINC 793 716 845 BARIUM 0		PHOSPHORUS	727	624		703					
BARIUM 0 <td></td> <td>ZINC</td> <td>793</td> <td>716</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>845</td>		ZINC	793	716						845	
Values Should Be* SUS Viscosity @ 210°F 63.6 59-65 cSt Viscosity @ 100°C 11.22 9.9-11.9 Flashpoint in °F 405 >375 Fuel % <0.5	8	BARIUM	0	0						0	
SUS Viscosity @ 210°F 63.6 59-65 Image: Construction of the second				Values Should Be*							
CSt Viscosity @ 100°C 11.22 9.9-11.9 Image: construction of the state of t		SUS Viscosity @ 210°F	63.6	59-65	l.			1	1		
Flashpoint in °F 405 >375 Image: Construction of the second s		cSt Viscosity @ 100°C	11.22	9.9-11.9							
Fuel % <0.5 <2.5 Antifreeze % 0.0 0.0 Water % 0.0 <0.1	S	Flashpoint in °F	405	>375							
Antifreeze % 0.0 0.0 0.0 0.0 Vater % 0.0 <0.1	Ë	Fuel %	< 0.5	<2.5]	
Water % 0.0 <0.1 Insolubles % 0.2 <0.6	R	Antifreeze %	0.0	0.0							
Insolubles % 0.2 <0.6 TBN </td <td>Ы</td> <td>Water %</td> <td>0.0</td> <td><0.1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Ы	Water %	0.0	<0.1							
TBN Image: Second sec	SO	Insolubles %	0.2	<0.6							
TAN Iso Code Iso Code	Ы	TBN				ļ.					
ISO Code		TAN]					
		ISO Code									

Story continues: I flushed out the power head with kerosene and scrubbed all the grit I could reach out of the valve train. I soaked the cylinder in a mix of SeaFoam and penetrating oil overnight. In the morning I was able to break the cylinder free by gently rocking the flywheel back and forth. After freeing the piston I flushed out the kerosene and put in fresh motor oil. Once the motor was moving freely I decided to put a spark plug onto the boot to see if the ignition system had survived being soaked in seawater for so long. And much to my surprise, it started making spark! The carburetor was in poor shape. It likely had ethanol gas in it when it went under and it had reacted with the salt water to nearly completely fill the interior of the carb and fuel system with a thick, white crystalline deposit. So I swapped on a spare 5 hp carb from my other Tohatsu and plugged a fuel tank directly into the replacement carburetor. I set everything up outside in a barrel full of of water. And after maybe 10 pulls and much coughing and sputtering, the motor started and ran! At that point I hadn't replaced any parts except the temporary carburetor.

The above sample was taken after repairing the broken valve spring (see the next part of the story). Doesn't look great, but most of the metal is from the wear-in process. Sodium has improved a lot.

This is the lower unit on the Tohatsu unit that was recovered from a year underwater. No surprises here!

To learn more about where the elements are coming from, click here.

	MI/HR on Oil						
	MI/HR on Unit						UNIVERSAL
	Sample Date	1/10/2018	AVERAGES				AVERA GES
	Make Up Oil Added		A VERAOES				22
	3	8		8	8		
NC	ALUMINUM	111	111	2	2		28
ľ	CHROMIUM	6	6	2	2	- 00	2
	IRON	610	610		2		187
	COPPER	38	38				7
EB	LEAD	6	6				2
Ъ	TIN	3	3				1
S	MOLYBDENUM	1	1				12
Ľ,	NICKEL	5	5				2
ΡA	MANGANESE	4	4				2
N	SILVER	0	0				0
	TITANIUM	1	1	12	12		0
SL	POTASSIUM	2	2	18	18-		1
2	BORON	39	39	3	5		26
	SILICON	5	5		0		4
	SODIUM	38	38	-			11
ш	CALCIUM	8	8				130
	MAGNESIUM	3	3			0	50
	PHOSPHORUS	925	925				529
	ZINC	418	418		0. 		131
	BARIUM	10	10				3
		65	Values			50 50	50 - 10
			Should Be*			<u> </u>	10
	SUS Viscosity @ 210°F	50.8	49-82				
	cSt Viscosity @ 100°C	7.51	7.0-16.3	3	3		
S	Flashpoint in °F	415	>405	2	2	- 22	
Ē	Fuel %	-	2		8	0	
Ж	Antifreeze %	?					
ä	Water %	POS	<0.5				
So	Insolubles %	0.3	<0.8				
а.	TBN						
	TAN						
	ISO Code						

Story continues: The motor is still quite crusty inside, even with the cleaning. And I've since had a few parts failures. The first part to fail was the exciter coil under the flywheel. After ordering a new one and replacing it, the motor ran again. The next failure, after about an hour of run time, was the intake valve spring (see the initial Report of the Month). When that spring broke it released the half-moon clips that secured the valve and sent the intake valve into the combustion chamber, bending the valve and temporarily stopping the the engine. I removed the intake valve from the combustion chamber, ordered a new one, and replaced it along with the intake and exhaust springs (just for peace of mind).

Blackstone notes: The first and second samples in this series are the reports from right after the spring broke, then the follow-up sample after it was repaired. This sample is from the boat's lower unit, and you've already read in Ryan's article what a problem lower units can be. This one did not handle the submerging as well as the engine did. Iron and aluminum are high, and copper is out of line too. Significant water contamination is present though we're surprised sodium only read 38 ppm.

What are we looking at in this report?

To learn more about where the elements are coming from, click here.

	MI/HR on Oil	2			
	MI/HR on Unit				UNIVERSAL
	Sample Date	1/18/2018	AVERAGES		AVERA GES
	Make Up Oil Added				
			19	Both images are from the fuel ports. Not pretty.	
N	ALUMINUM	3	10		6
Ĭ	CHROMIUM	0	0		1
	IRON	3	64		24
	COPPER	1	3		7
£	LEAD	1	1		2
α.	TIN	0	0		0
S	MOLYBDENUM	131	115		95
К	NICKEL	0	0		0
Ы	MANGANESE	0	0	and the second	0
	SILVER	0	0		0
	TITANIUM	0	©0.		0
Ě	POTASSIUM	1	1		1
Ĩ.	BORON	82	84	Statement of the second s	48
Ū.	SILICON	5	6		11
	SODIUM	21	17		11
ш	CALCIUM	1488	1335		1692
	MAGNESIUM	32	248		68
	PHOSPHORUS	561	624		703
	ZINC	673	716		845
	BARIUM	0	0		0
			Values	Active as the second second second	
	a successive and the second second		Should Be*		
	SUS Viscosity @ 210°F	67.4	65-76		
	cSt Viscosity @ 100°C	12.25	11.6-14.8		2-
5	Flashpoint in °F	385	>375		
Ξ	Fuel %	<0.5	<3.0		
Ч	Antifreeze %	0.0	0.0		
Ы	Water %	0.0	<0.1		2
20	Insolubles %	TR	<0.6		8
Ы	TBN				
	TAN				
	ISO Code				

This oil sample is a reference sample from the owner's other Tohatsu engine, to see how metals should look. Maybe with a little luck and a lot of TLC, the submerged engine will eventually wear like this. Time will tell.

Story continues: To date, I've continued to run the motor periodically and I've got it to the point now that ir runs just about well enough to trust it out on the water. It will be an interesting experiment to see how long the engine keeps running.