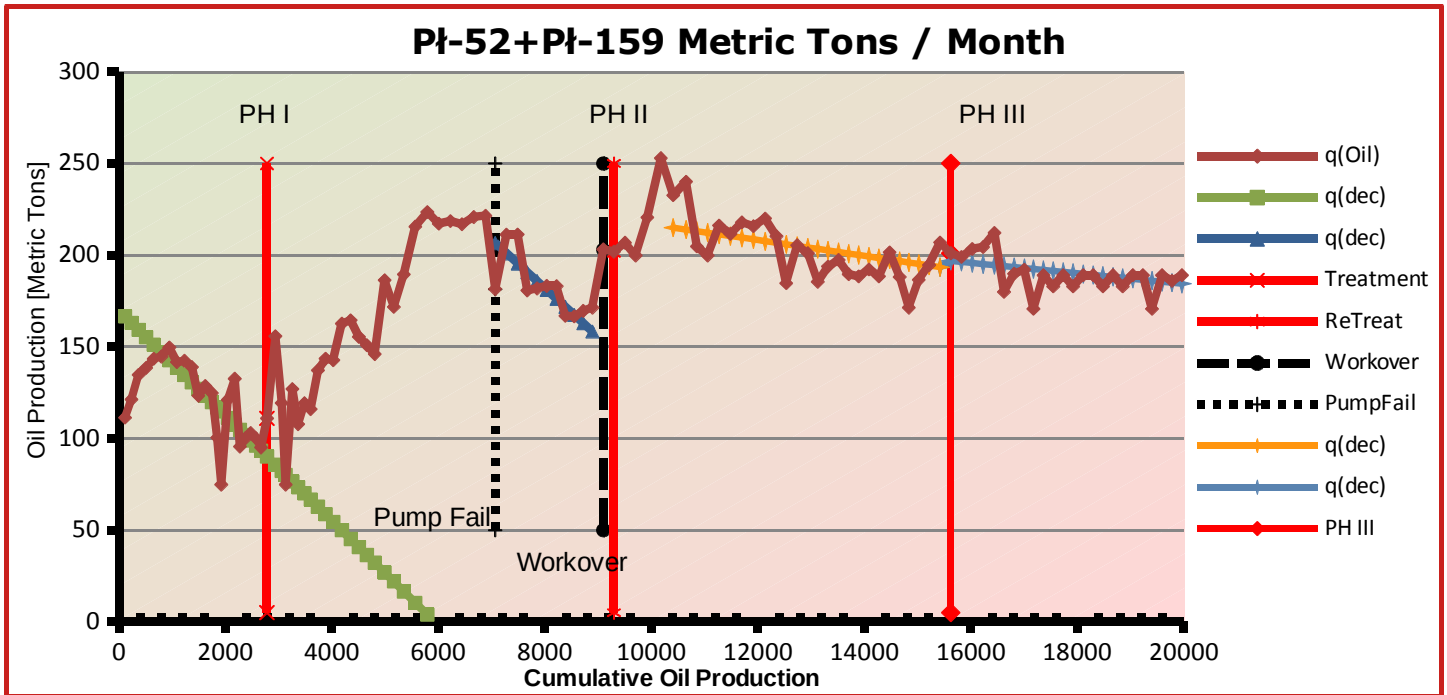


# Microbial Assisted Waterflood (MAW) at Plawowice Oil Field near Krakow, Poland

Combined oil production from two project oil wells graphed over a 10+ year period - 24 months waterflooding prior to microbial treatment and 98 months after microbial treatment. Major project events are described in the narrative below. A third injector / producer system added in Phase II project expansion is not included.



The first trend line (green) reflects the waterflood's untreated production decline over 24 months beginning at [T(0)=November 2009]. When projected to exhaustion the cumulative untreated production is ~6000 MT. Phase I began in October 2011 with an initial microbial treatment (first vertical red line). Production trends upward for 25 months until a pump failure (black dotted vertical line). This event denotes the end of Phase I. Data reflects a second steep decline trend was established following the pump failure (dark blue dotted line). Phase II re-treatment took place in October 2014 using a slightly different microbial composition (second vertical red line). Early results from Phase II indicate a workover arrested the second decline trend (dark blue dotted line) and subsequent microbial re-treatment established a new more shallow decline (orange dotted line). This new trend continued to month 80 (Jun 2017) when Phase III was initiated by fresh microbial re-treatment (third vertical red line). A slower decline trend (more shallow slope of exhaustion) becomes evident which is maintained in Phase III to month 98 (Dec 2019) (medium blue dotted line). Total cumulative oil production from Phase I (Sep 2011) to Dec 2019 of ~21000 MT was adjusted by subtracting the projected untreated production of ~6000 Cumulative MT. Results: Microbially Assisted Waterflooding (MAW) has produced ~15,000 MT (~111,000 bbls) of incremental oil from 2 project oil wells in 98 months.

Note: The Plawowice MAW project is still active as of February, 2020.



Polish Oil and Gas Institute  
National Research Institute (INiG-PIB)



Polish Oil & Gas Company



RAM Biochemicals