pwptemp

Release 0.3.1

Pro Well Plan AS

Mar 02, 2021

CONTENTS:

Find here the documentation of pwptemp. Here you will find all the relevant information about any function included in this package.

CHAPTER

ONE

INSTALLATION

pwptemp is written to be compatible with Python 3+. The best way to install is using pip.

```
$ pip install pwptemp
```

This will make sure that all the dependencies are installed. This requirements are listed below.

1.1 Requirements

- numpy
- torque_drag
- scipy
- plotly

CHAPTER

TWO

TEMPERATURE DURING DRILLING

pwptemp.**calc_temp**(*trajectory*, *casings=None*, *set_inputs=None*, *operation='drilling'*, *time_steps=210*, *smooth=True*, *cells_no=None*)

Function to calculate the well temperature distribution during a specific operation at a certain time.

Parameters

- **trajectory** – wellbore trajectory excel|csv|dataframe|list
- **casings** – list of dictionaries with casings characteristics (od, id and depth)
- **set_inputs** – dictionary with parameters to set.
- **operation** – define operation type. ('drilling', 'circulating')
- **time_steps** – number of time steps to run calculations.
- **smooth** – smooth the temperature profiles.
- **cells_no** – (int) number of cells. If None -> keep same number of cells than trajectory

Returns Well temperature distribution object

pwptemp.**temperature_behavior**(*well*)

Function to simulate the temperature behavior.

Parameters **well** (*obj*) – well temperature distribution object

Returns temperature behavior object

2.1 Example

```
>>> import pwptemp as pt
>>> import well_profile as wp

>>> trajectory = wp.load('trajectory1.xlsx', equidistant=True)      # using well_
↪profile to load a trajectory

>>> casings = [{'od': 12, 'id': 11, 'depth': 1200},        # creating 3 casings with␣
↪respective parameters
>>>             {'od': 10, 'id': 9, 'depth': 1500},        # diameter [in] and depth [m]
>>>             {'od': 8, 'id': 7, 'depth': 2400}]

>>> rop_list = [50, 45, 40, 35]      # setting respective ROP [m/h] for each section

>>> well = pt.calc_temp(trajectory,      # calculate the well temperature distribution␣
↪using pwptemp
```

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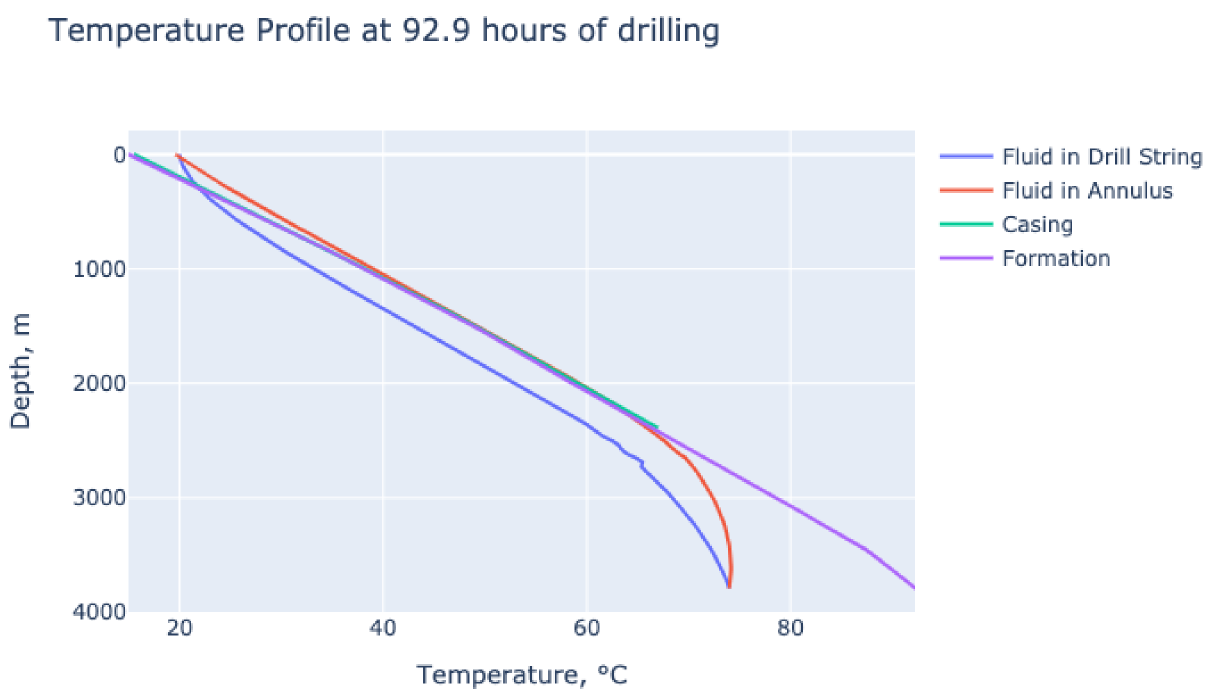
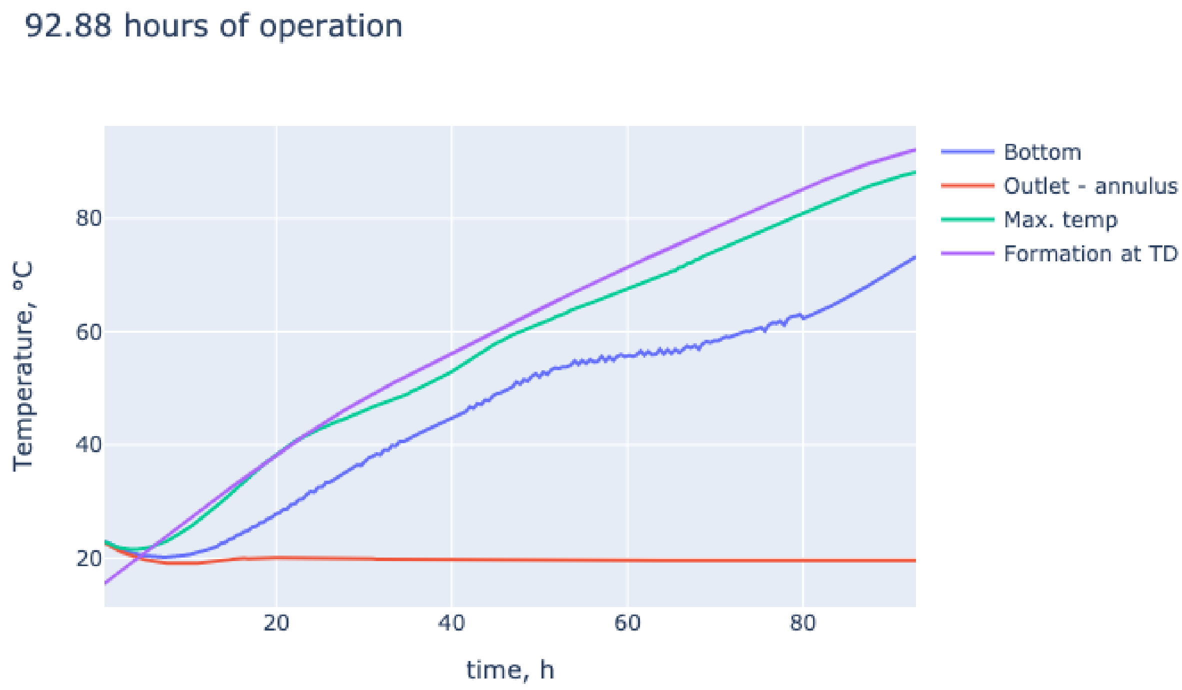
```
>>>                         casings,
>>>                         set_inputs={'water_depth': 0, 'temp_inlet': 20, 'rop':rop_
↪list,
>>>                         operation='drilling',}

>>> pt.plot_distribution(well).show()
```





Notice!

The total time of drilling is calculated based on the ROP's set for the sections. The simulation assumes a break after each section is drilled (here is when casing is run and cemented) so the temperature becomes stable again. i.e. for this particular case, it takes 92.9 hours only *drilling* the whole wellbore.

The table below shows the available inputs that can be set when using the parameter *set_inputs*

Name	Units
temp_inlet	°C
temp_surface	°C
water_depth	in
pipe_id	in
pipe_od	in
riser_id	in
riser_od	in
fm_diam	in
flowrate	m3/min
Thermal Conductivities———–	
tc_fluid	W / (m °C)
tc_csg	W / (m °C)
tc_cem	W / (m °C)
tc_pipe	W / (m °C)
tc_fm	W / (m °C)
tc_riser	W / (m °C)

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Table 1 – continued from previous page

Name	Units
tc_seawater	W / (m °C)
Specific Heat Capacities————	
shc_fluid	J / (kg °C)
shc_csg	J / (kg °C)
shc_cem	J / (kg °C)
shc_pipe	J / (kg °C)
shc_riser	J / (kg °C)
shc_seawater	J / (kg °C)
shc_fm	J / (kg °C)
Densities————————	
rho_fluid	sg
rho_pipe	sg
rho_csg	sg
rho_riser	sg
rho_fm	sg
rho_seawater	sg
rho_cem	sg
Others—————————	
th_grad_fm	°C/m
th_grad_seawater	°C/m
hole_diam	m
rpm	rev. per min.
tbit	kN*m
wob	kN
rop	m/h
an	in^2
bit_n	0 to 1
dp_e	0 to 1
thao_o	Pa
beta	Pa
alpha	1/°C
k	Pa*s^n
n	dimensionless
visc	cP

2.2 Web Application

There is also the web-app based on pwptemp:

CHAPTER

THREE

TEMPERATURE DURING CIRCULATING

pwptemp.**calc_temp**(*trajectory*, *casings=None*, *set_inputs=None*, *operation='drilling'*, *time_steps=210*, *smooth=True*, *cells_no=None*)

Function to calculate the well temperature distribution during a specific operation at a certain time.

Parameters

- **trajectory** – wellbore trajectory excel|csv|dataframe|list
- **casings** – list of dictionaries with casings characteristics (od, id and depth)
- **set_inputs** – dictionary with parameters to set.
- **operation** – define operation type. ('drilling', 'circulating')
- **time_steps** – number of time steps to run calculations.
- **smooth** – smooth the temperature profiles.
- **cells_no** – (int) number of cells. If None -> keep same number of cells than trajectory

Returns Well temperature distribution object

pwptemp.**temperature_behavior**(*well*)

Function to simulate the temperature behavior.

Parameters **well** (*obj*) – well temperature distribution object

Returns temperature behavior object

3.1 Example

```
>>> import pwptemp as pt
>>> import well_profile as wp

>>> trajectory = wp.load('trajectory1.xlsx', equidistant=True)      # using well_
↪profile to load a trajectory

>>> casings = [{'od': 12, 'id': 11, 'depth': 1200},       # creating 3 casings with␣
↪respective parameters
>>>            {'od': 10, 'id': 9, 'depth': 1500},        # diameter [in] and depth [m]
>>>            {'od': 8, 'id': 7, 'depth': 2400}]

>>> well = pt.calc_temp(trajectory,      # calculate the well temperature distribution␣
↪using pwptemp
>>>                     casings,
>>>                     set_inputs={'water_depth': 0,        # water depth [m]
```

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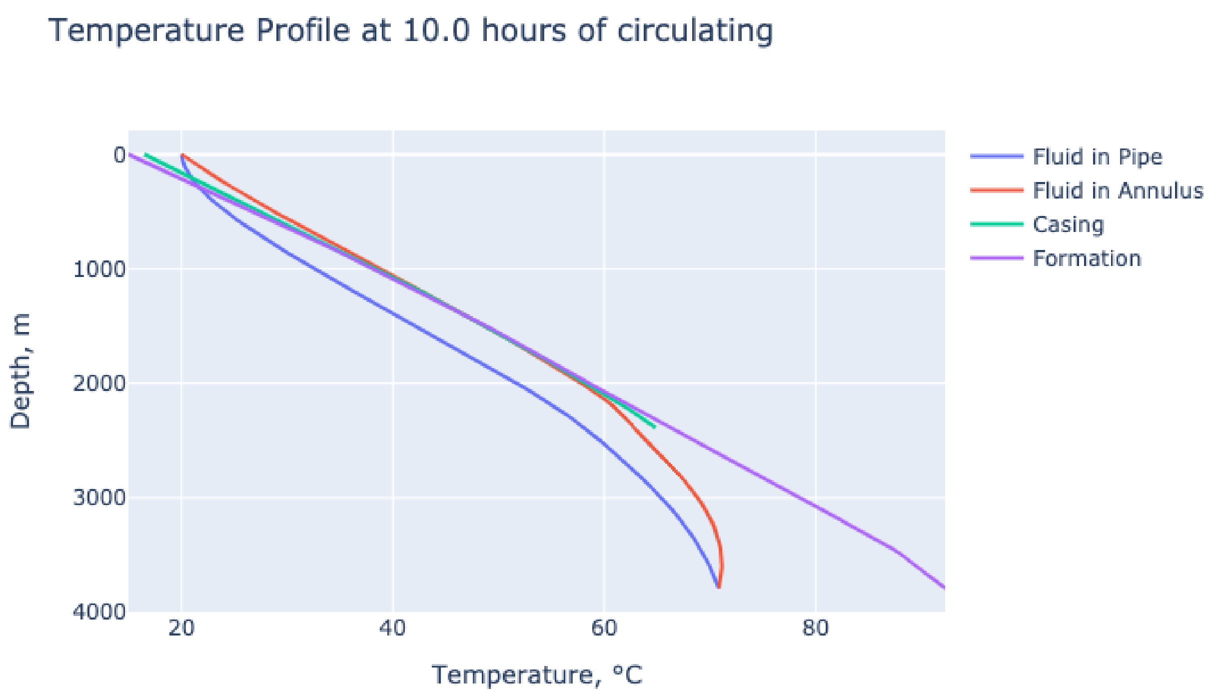
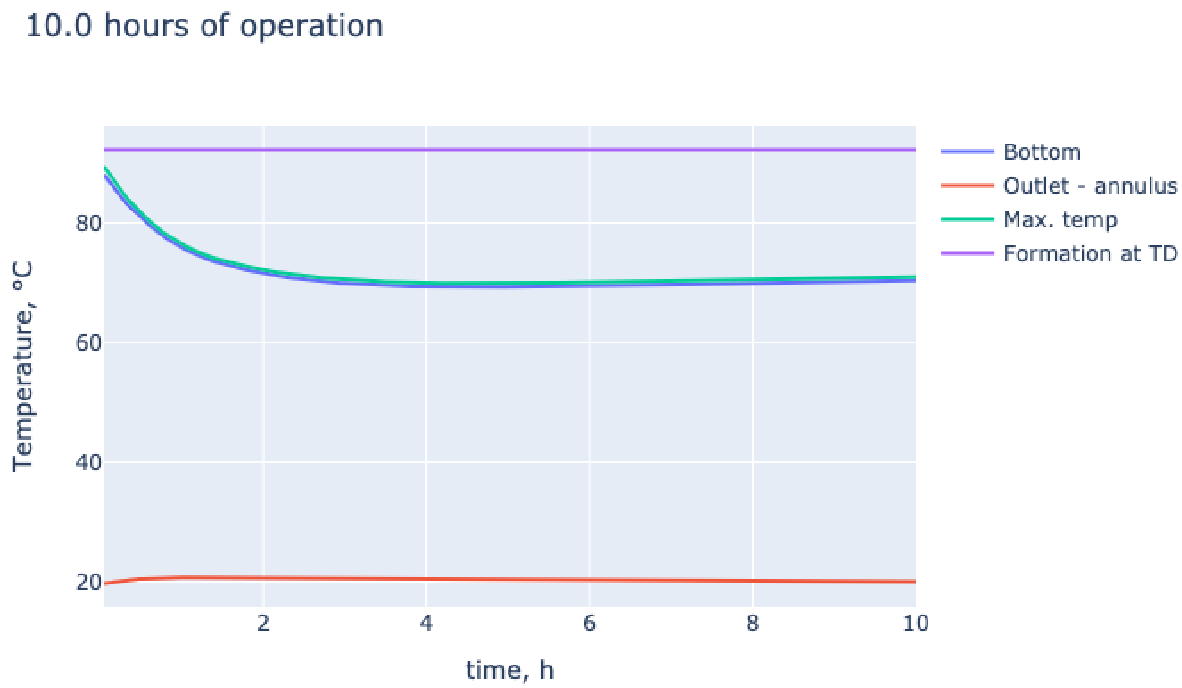
```
>>>                                  'temp_inlet': 20,       # inlet fluid temperature␣
↪[°C]
>>>                                  'time': 10}             # circulation time [h]
>>>                      operation='circulating',

>>> pt.plot_distribution(well).show()
```





The table below shows the available inputs that can be set when using the parameter *set_inputs*

Name	Units
time	h
temp_inlet	°C
temp_surface	°C
water_depth	in
pipe_id	in
pipe_od	in
riser_id	in
riser_od	in
fm_diam	in
flowrate	m3/min
Thermal Conductivities——————-	
tc_fluid	W / (m °C)
tc_csg	W / (m °C)
tc_cem	W / (m °C)
tc_pipe	W / (m °C)
tc_fm	W / (m °C)
tc_riser	W / (m °C)
tc_seawater	W / (m °C)
Specific Heat Capacities—————	
shc_fluid	J / (kg °C)
shc_csg	J / (kg °C)
shc_cem	J / (kg °C)
shc_pipe	J / (kg °C)

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Table 1 – continued from previous page

Name	Units
shc_riser	J / (kg °C)
shc_seawater	J / (kg °C)
shc_fm	J / (kg °C)
Densities————————	
rho_fluid	sg
rho_pipe	sg
rho_csg	sg
rho_riser	sg
rho_fm	sg
rho_seawater	sg
rho_cem	sg
Others—————————	
th_grad_fm	°C/m
th_grad_seawater	°C/m
hole_diam	m
rpm	rev. per min.
tbit	kN*m
wob	kN
rop	m/h
an	in^2
bit_n	0 to 1
dp_e	0 to 1
thao_o	Pa
beta	Pa
alpha	1/°C
k	Pa*s^n
n	dimensionless
visc	cP

3.2 Web Application

There is also the web-app based on pwptemp:

CHAPTER

FOUR

ABOUT PRO WELL PLAN

Pro Well Plan offers an easy and effective well planning platform for the entire team. Check out our website to know more about us.

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