Stand-alone Plasma Controller for Air Cleaning System

Graduate

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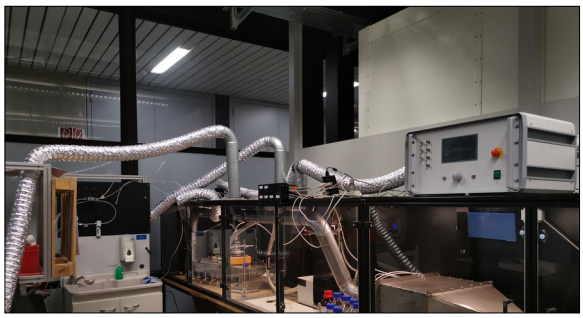
Introduction: Air cleaning systems are a key element that must be discussed and improved, in order to guarantee a safe and healthy work environment. Nowadays, there are several ways to clean and purify air and these are mostly multilayer systems. These systems are composed by different types of filters. A good air cleaning level can be obtained by cascading some of these filters depending on which pollutants are present in the air. In this study the focus will be concentrated on a single filter that burns the pollution particles by letting the airflow to pass trough many plasma tubes. The objective of this study is to develop a stand-alone program, whose application is to manage, debug and measure a whole air cleaning installation. The process must also be able to work in automation and guarantee some parameters given by the user.

Approach: In this project, the air cleaning system will be completely simulated in a laboratory at the OST by the UMTEC. In this simulation a clean air flow will be mixed with a highly polluted one in order to obtain a factory-like polluted airflow. The focus of the thesis has been put only on one substance, the Dimethyl Carbonate (DMC). The development of the control device is composed by three phases. The first phase is the analysis of the air pollution and cleaning process without any control theory application. This is necessary in order to understand the free behaviour of the system. The second phase of the development consists in the controller's setup to automate the whole system. The third phase is the actual implementation of the controller in the real system. Once the device is developed, it will be optimized and adapted to the specific needs of the UMTEC laboratory.

Conclusion: The thesis proves that the whole air cleaning process can be managed and successfully automated by a relatively simple program. All the devices can operate digitally and communicate by means of RS232 interfaces. Thanks to that, the solution can be applied with a Python code only and an eight ports serial adapter. When operating in automatic mode, the program is able to control the entire installation without any human operator.

Air cleaning installation
Own presentment

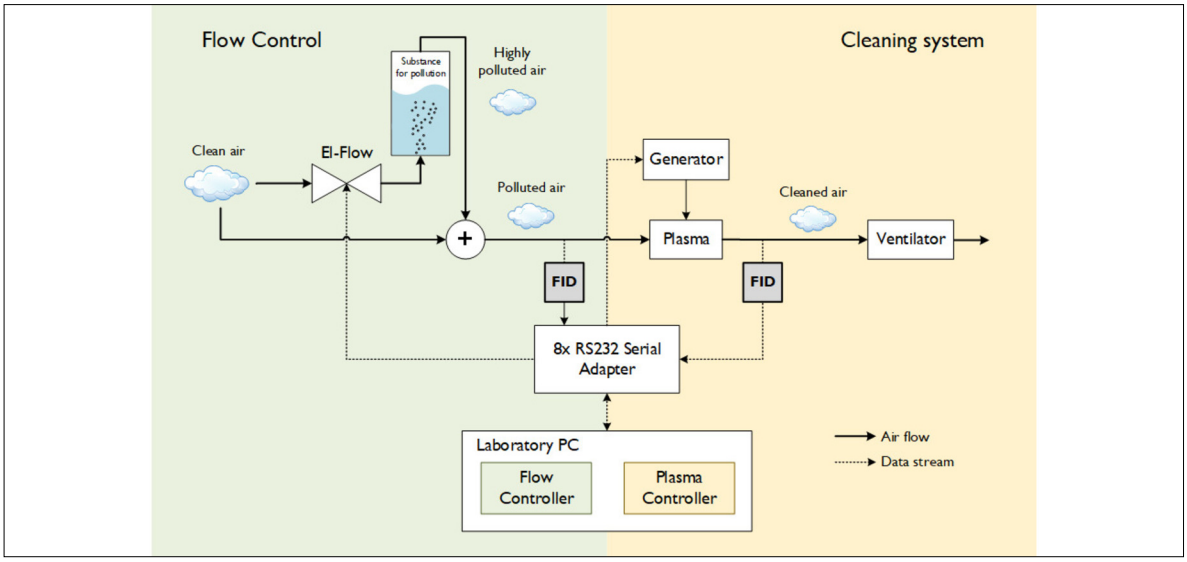


Two main functions of the Flow Controller
Own presentment

```python
def flowCtrlInit(flowCtrlSettings,fidSettings,flowSettings):
    global controller
    print("--- flow controller initialisation started ---")
    flowCtrlSettings['C1 [mgC]'] = getFID_AKO1(fidSettings)
    controller.SetPoint = flowCtrlSettings['C3setPoint [mgC]']
    showInit(flowCtrlSettings)
    flowSettings["ON [b]"] = 1
    print("--- flow controller initialisation finished ---")

def flowCtrlUpdate(now,flowCtrlSettings,fidSettings,flowSettings):
    print("\n -------- FLOW CONTROLLER UPDATE ",now,"--------")
    flowCtrlSettings['C3measured [mgC]'] = getFID_AKO1(fidSettings)   #mg/m3
    controller.update(flowCtrlSettings['C3measured [mgC]'])
    flowCtrlSettings['Output V2'] = controller.output
    flowCtrlSettings['Current Error'] = controller.last_error
    flowSettings["Flow [l/min]"] = flowCtrlSettings['Output V2']
    showControllerStatus(flowCtrlSettings,controller)
    sendflow(flowSettings)
    print("\n")
```

Flow chart of the two controllers
Own presentment



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Subject Area
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